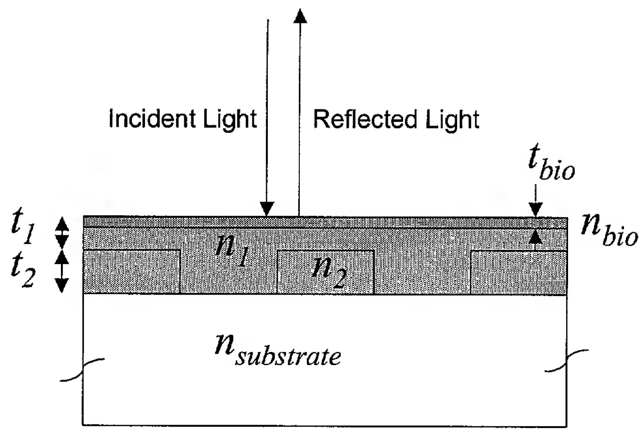


Figure 1 A

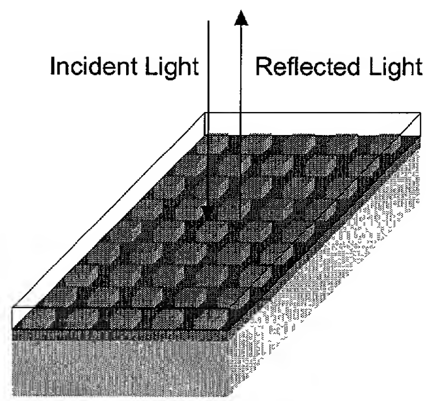


Figure 1 B

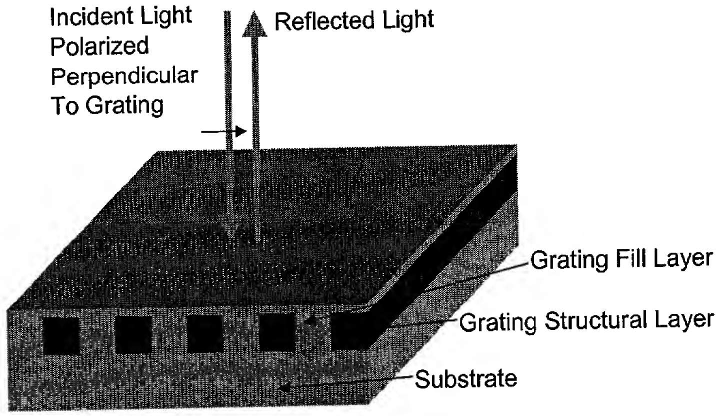

Incident Light
Polarized
Perpendicular
To Grating
Reflected Light
Grating Fill Layer
Grating Structural Layer
Substrate

Figure 2.

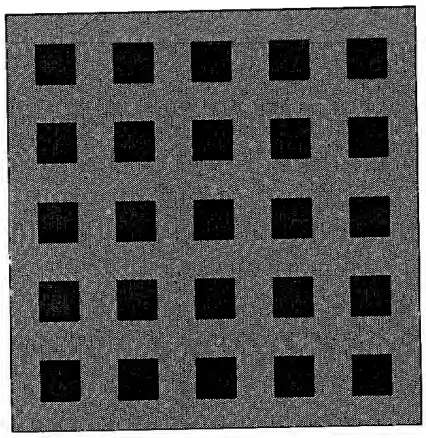


Figure 3A

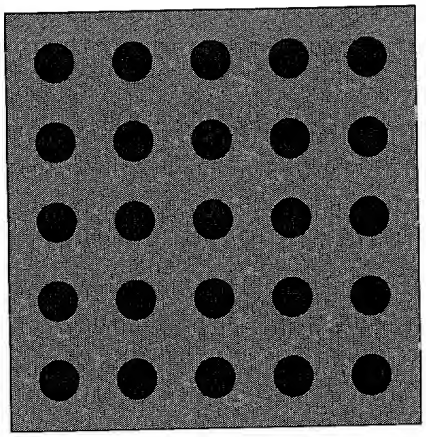


Figure 3B

Figure 3

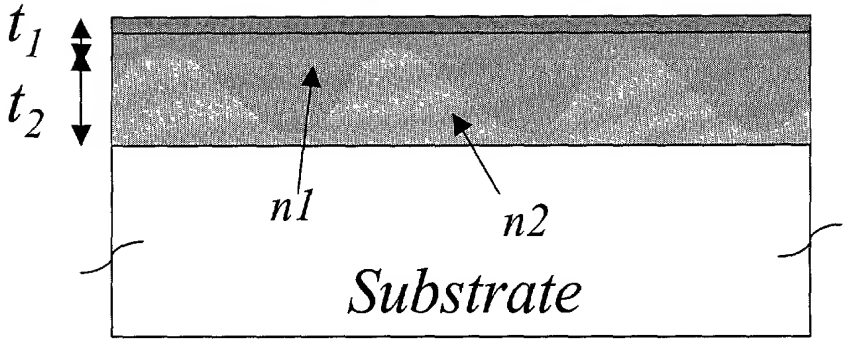


Figure 4.

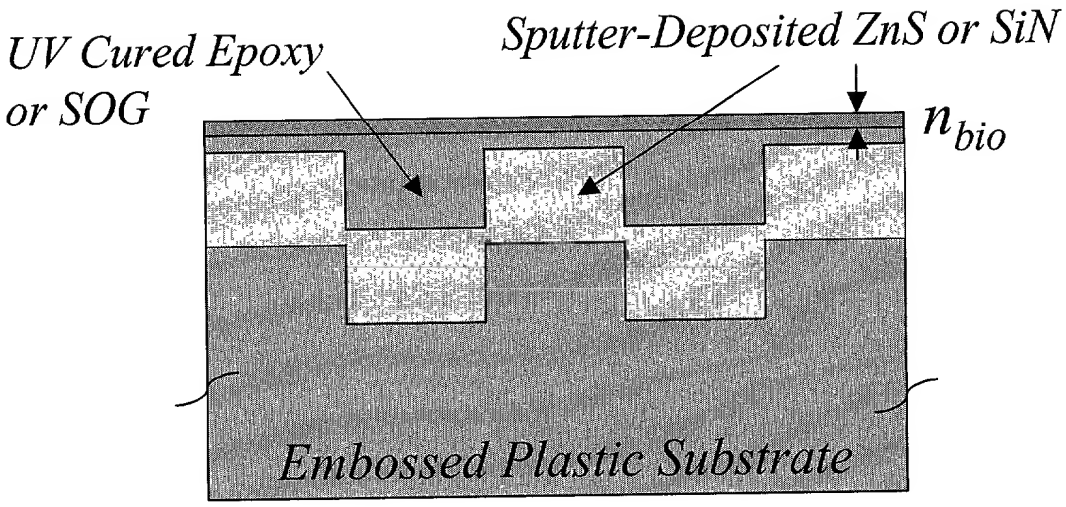
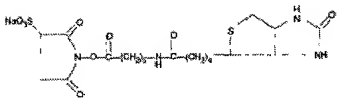

UV Cured Epoxy
or SOG
Sputter-Deposited ZnS or SiN
n_{bio}
Embossed Plastic Substrate

Figure 5.

Amine

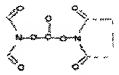
➢Sulfo-succinimidyl-6-(biotinamido)*hexanoate* (*Sulfo-NHS-LC-Biotin*)

•Streptavidin/avidin then biotinylated molecule



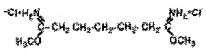
➢N,N'-disuccinimidyl carbonate (DSC)

•-NH_2, non-cleavable



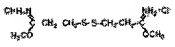
➢Dimethyl pimelimidate (DMP)

•-NH_2, non-cleavable



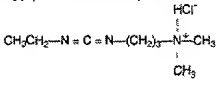
➢Dimethyl 3,3'-dithiobispropionimidate (DTBP)

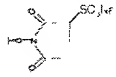
•-NH_2, cleavable



➢1-Ethyl-3-(3-Dimethylaminopropyl)carbodiimide *Hydrochloride* (EDC) & *N*-Hydroxysulfosuccinimide (Sulfo-NHS)

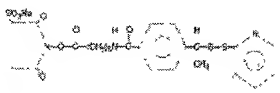
•-COOH





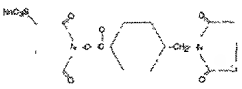
➢Sulfo-succinimidyl 6-[a-methyl-a-(2-pyridyl-*dithio*)*toluamido*]*hexanoate* (*Sulfo-LC-SMPT*)

•-SH, cleavable



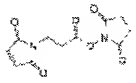
➢Sulfo-succinimidyl 4-(N-maleimidomethyl)cyclohexane-1-carboxylate (Sulfo-SMCC)

•-SH, non-cleavable



➢N-(ß-Maleimidopropyloxy) succinimide ester (BMPS)

•-SH, non-cleavable



Aldehyde ➢Directly with aldehyde or first amino then aldehyde

•-NH_2

Ni(II) ➢Using nitrilotriacetic acid (NTA) group, which forms a chelate with Ni(II)

•His-tagged molecules

Figure 6

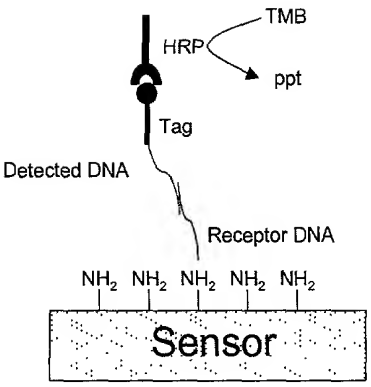


Figure 7A

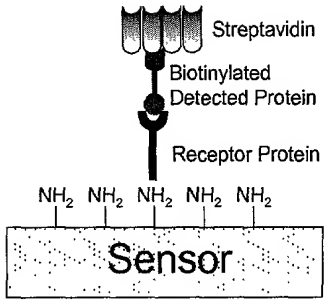


Figure 7B

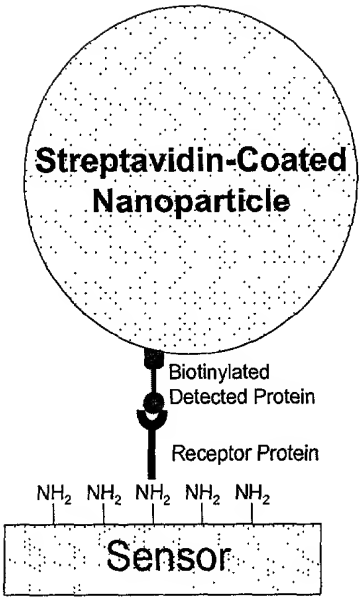


Figure 7C

Figure 7

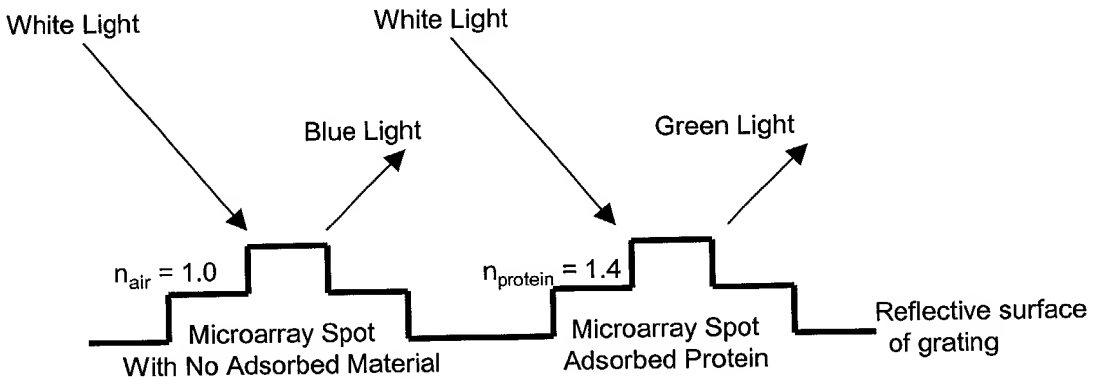


FIGURE 8

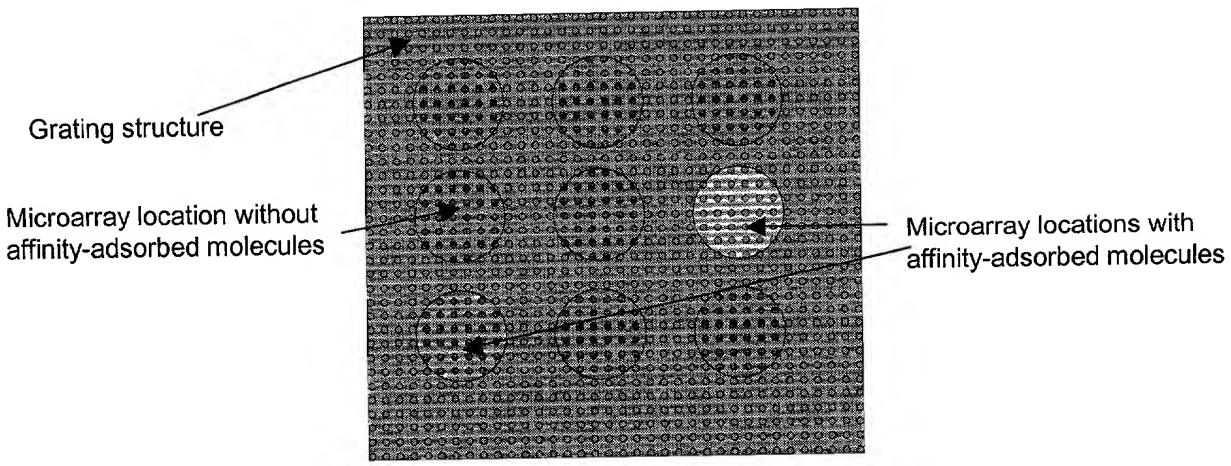

Grating structure
Microarray location without affinity-adsorbed molecules
Microarray locations with affinity-adsorbed molecules

FIGURE 9

❑ Microtiter plate

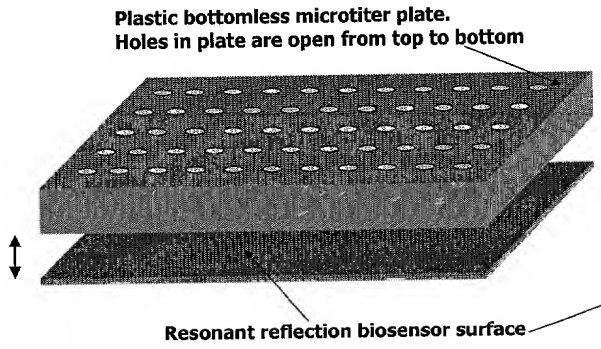


Figure 10A

❑ Microarray slide

Figure 10B

Figure 10

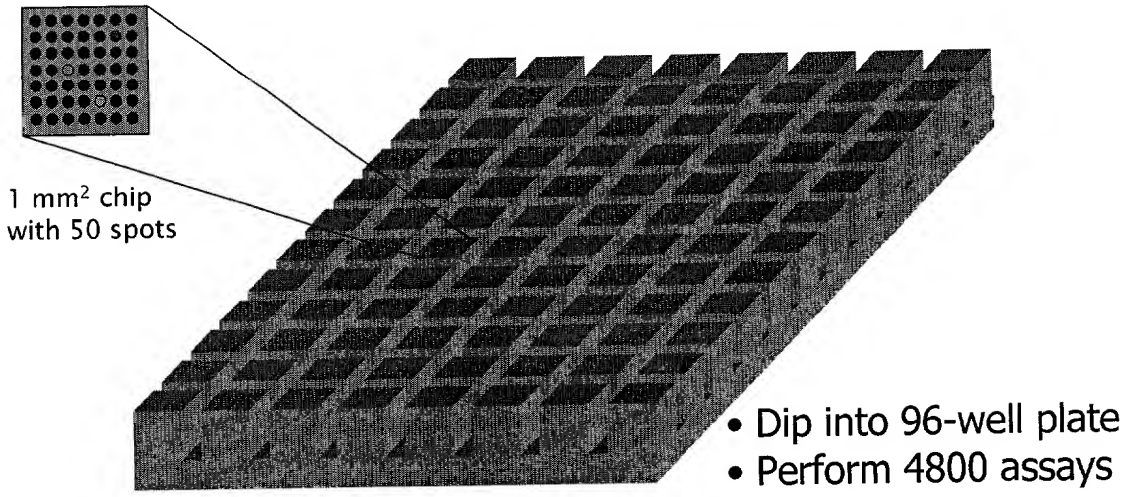

1 mm² chip
with 50 spots
• Dip into 96-well plate
• Perform 4800 assays

Figure 11

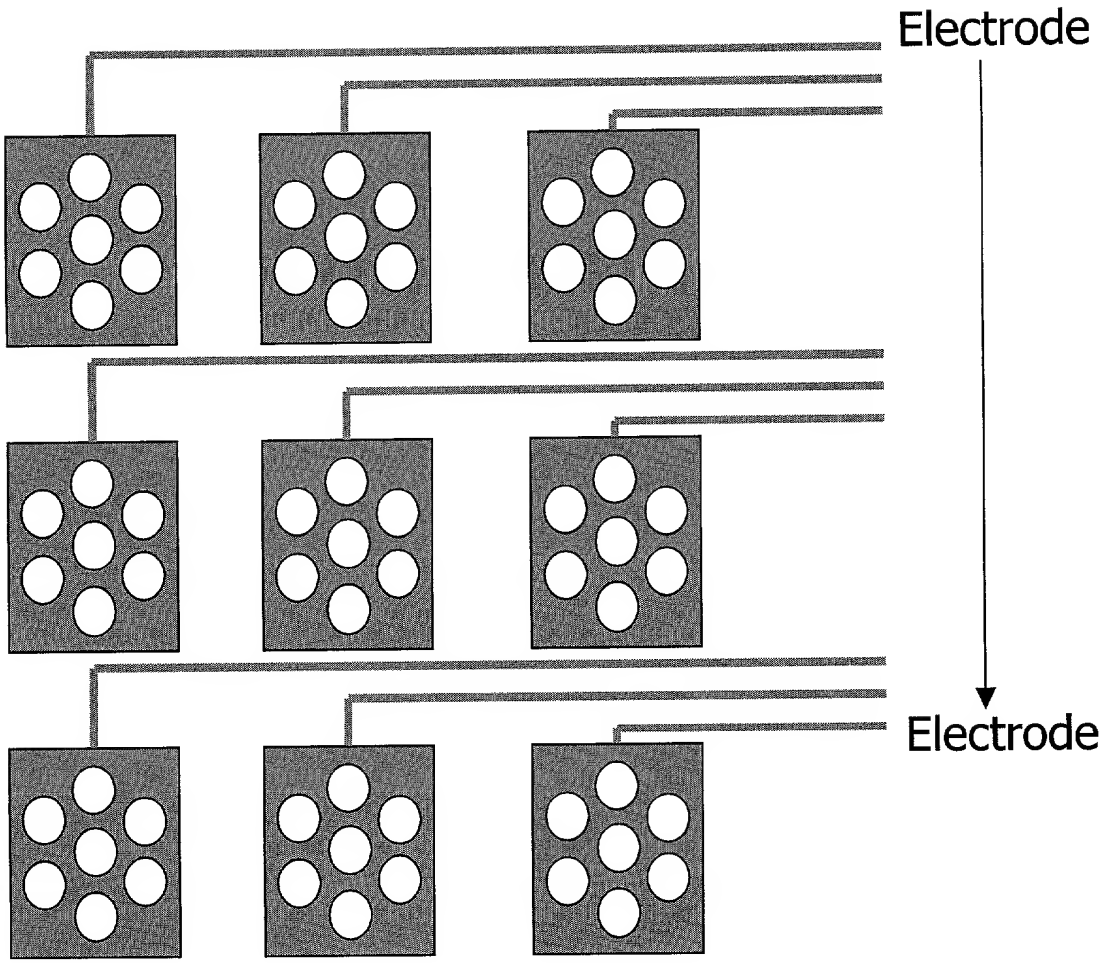


FIGURE 12

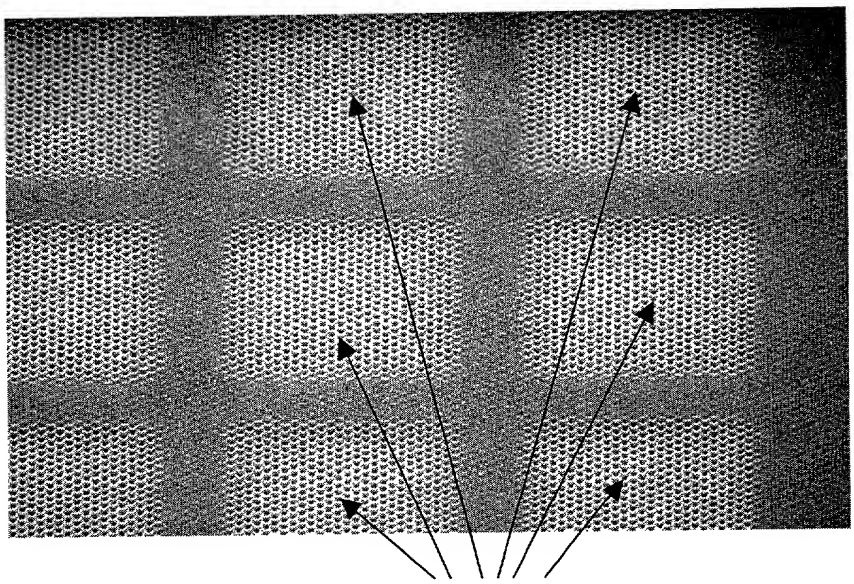


FIGURE 13

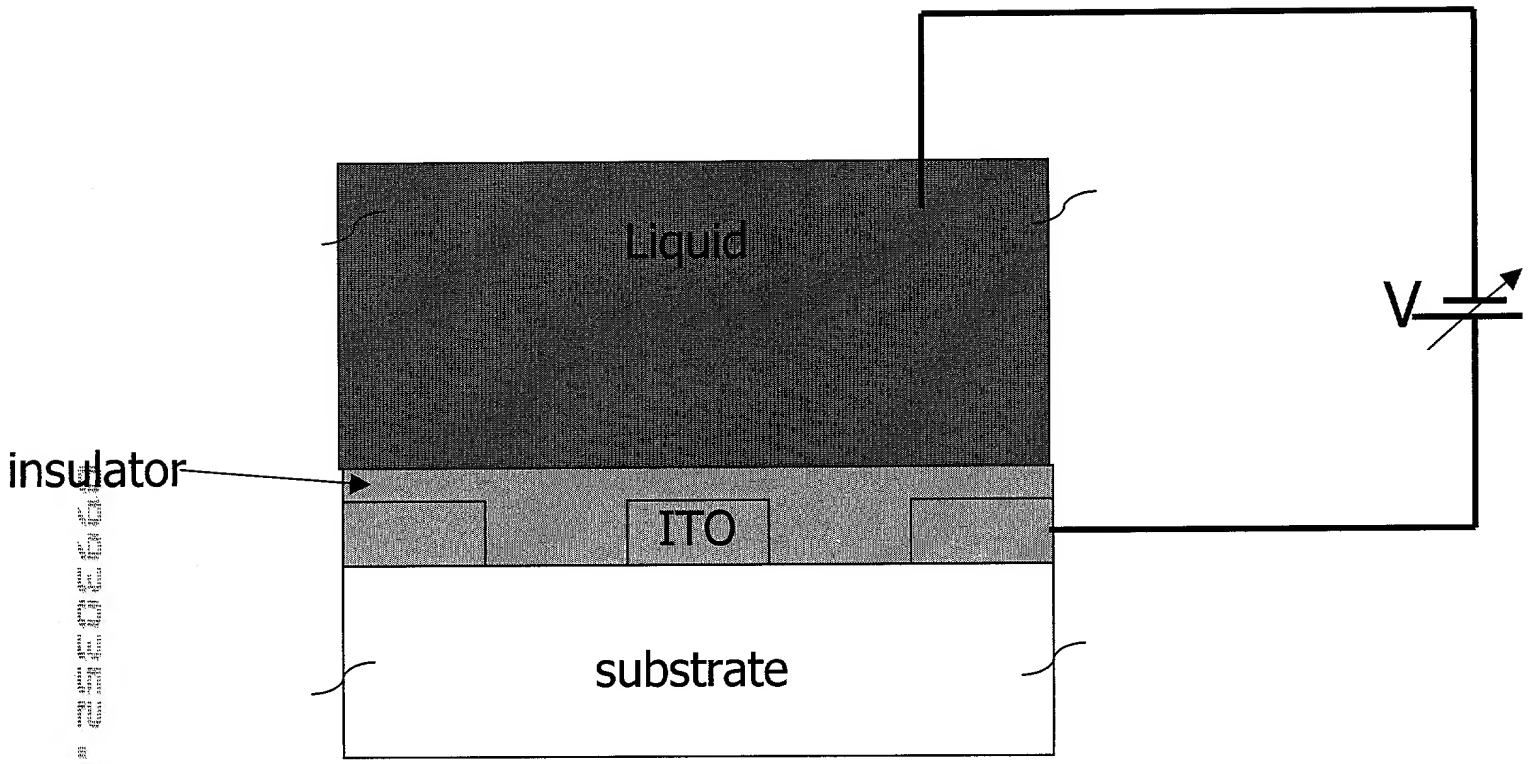


FIGURE 14

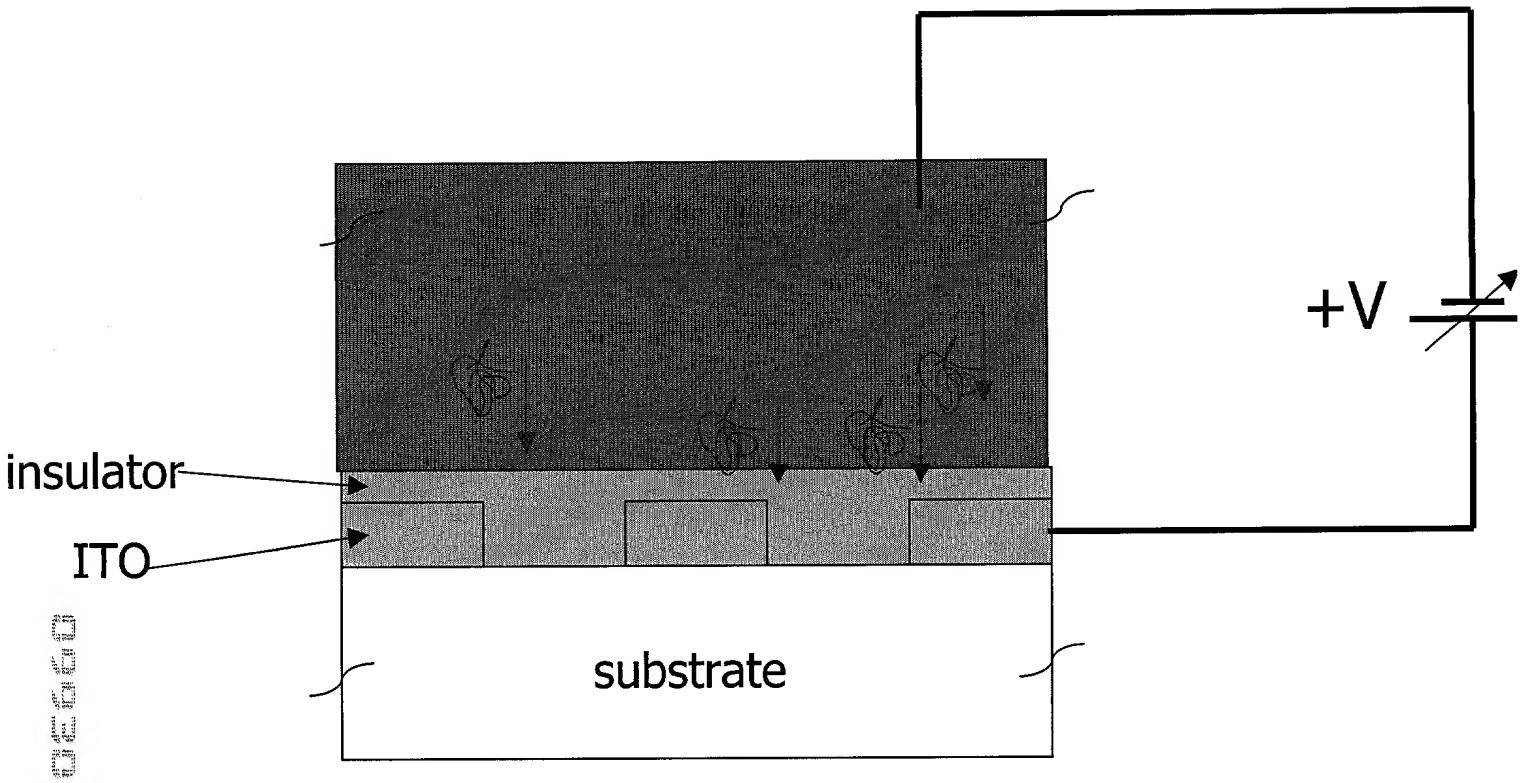


FIGURE 15

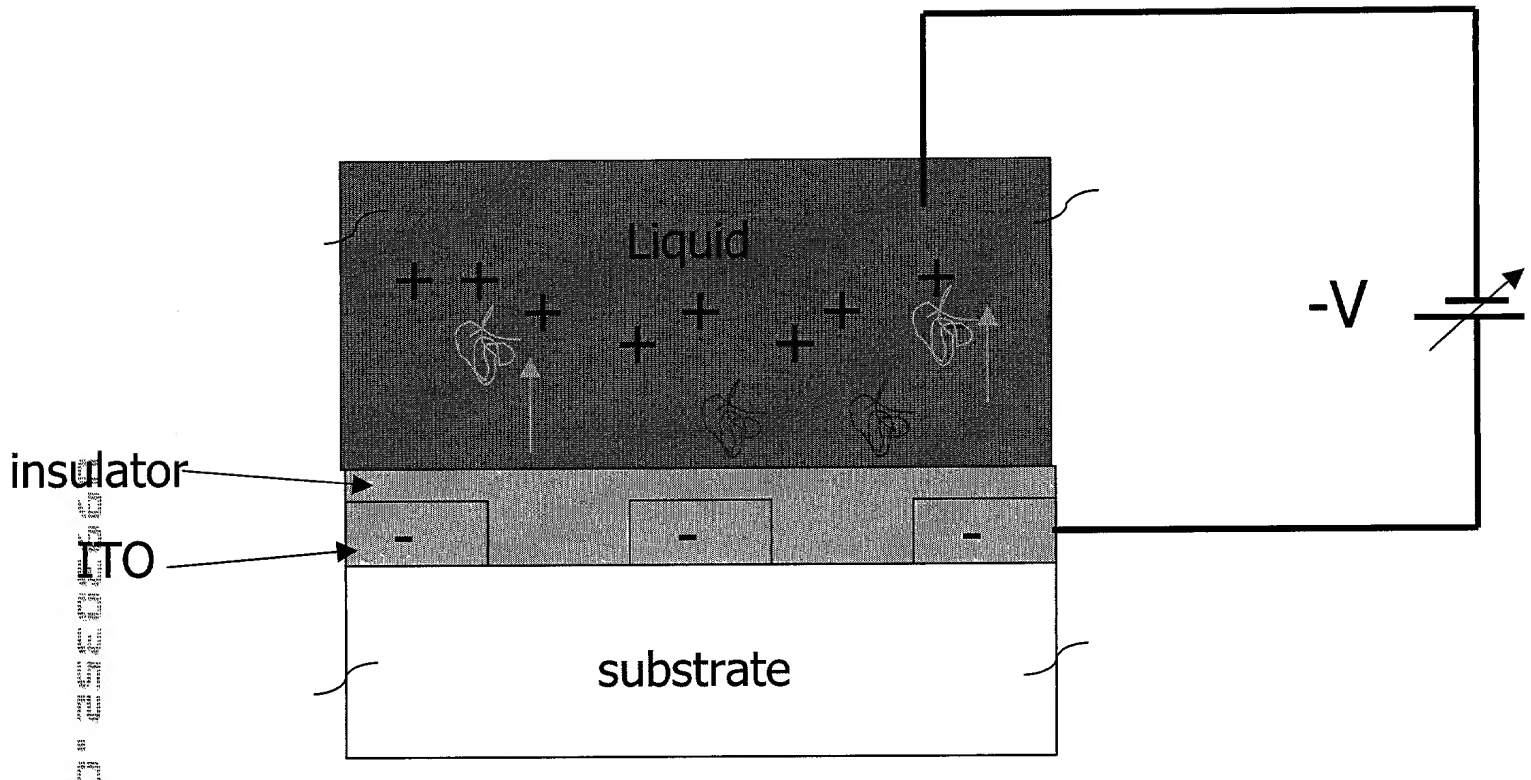


FIGURE 16

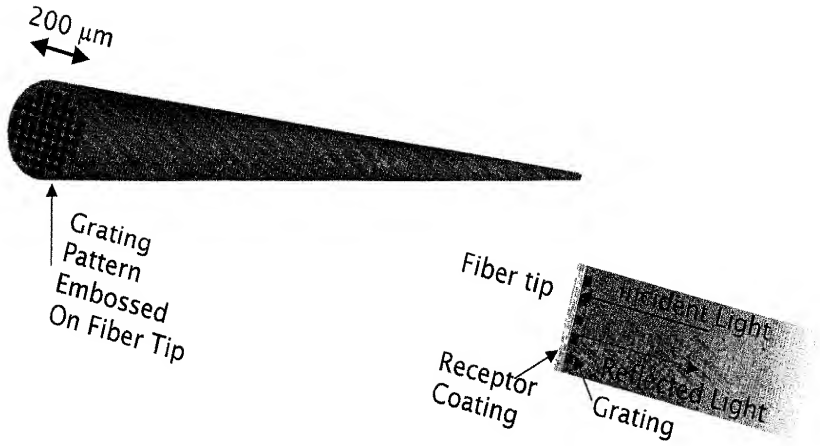

200 μm
Grating
Pattern
Embossed
On Fiber Tip
Fiber tip
Incident Light
Reflected Light
Receptor
Coating
Grating

Figure 17

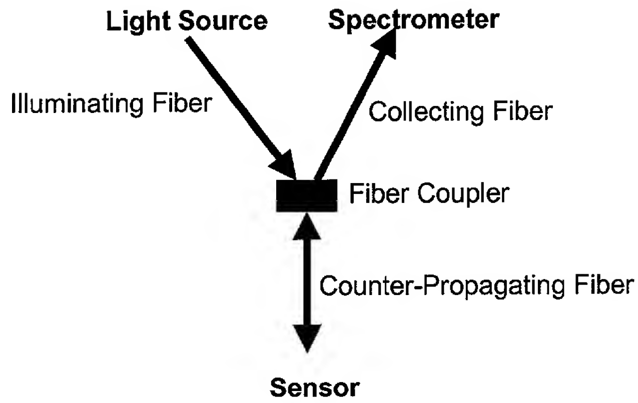

Light Source
Spectrometer
Illuminating Fiber
Collecting Fiber
Fiber Coupler
Counter-Propagating Fiber
Sensor

Figure 18

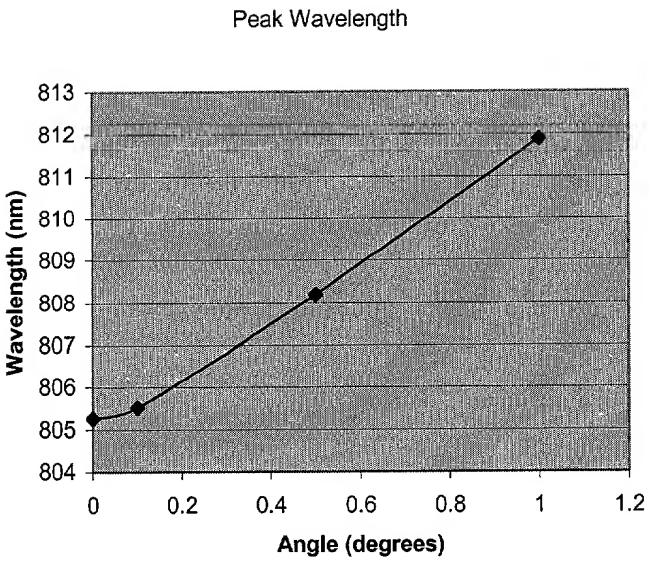

Peak Wavelength
Wavelength (nm)
813
812
811
810
809
808
807
806
805
804
0
0.2
0.4
0.6
0.8
1
1.2
Angle (degrees)

Figure 19

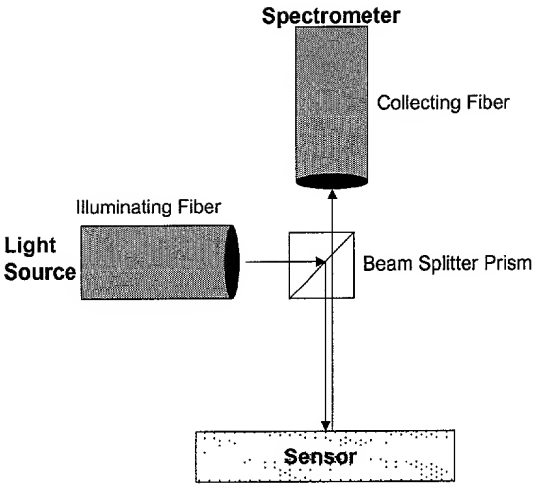

Spectrometer
Collecting Fiber
Illuminating Fiber
Light
Source
Beam Splitter Prism
Sensor

Figure 20

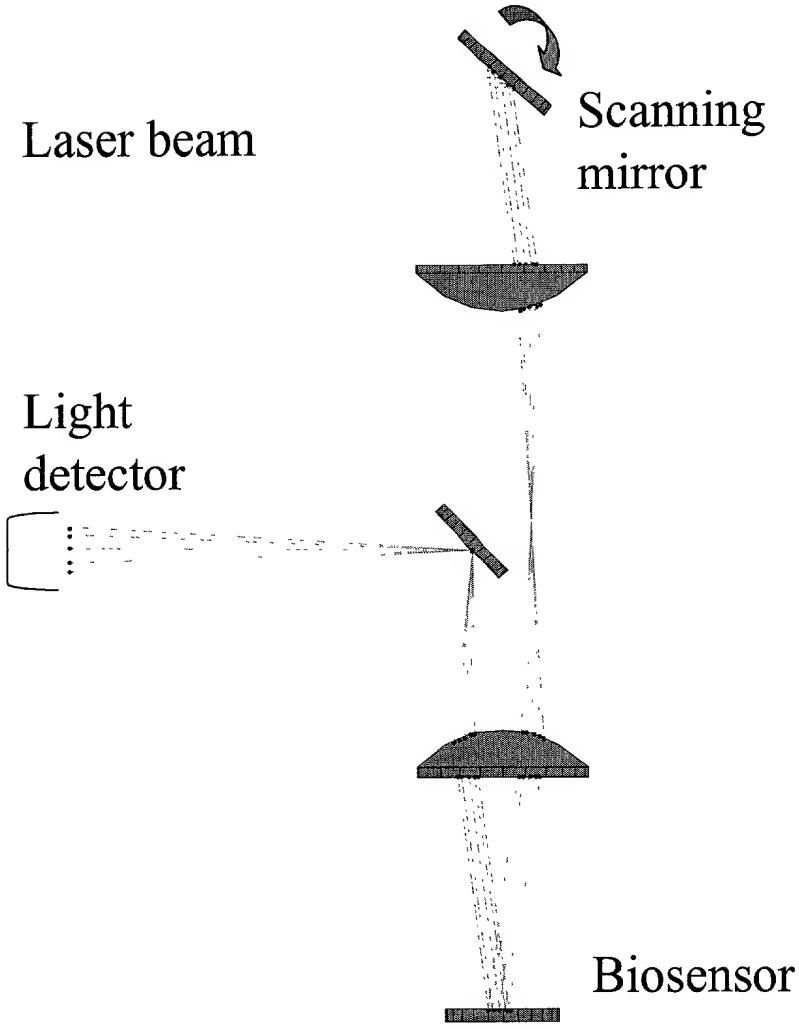


Figure 21

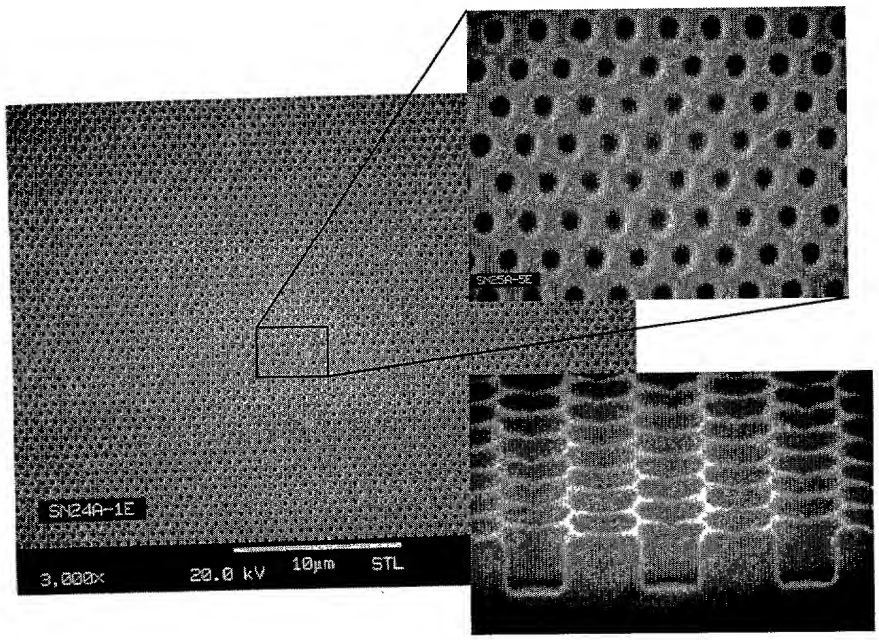


Figure 22

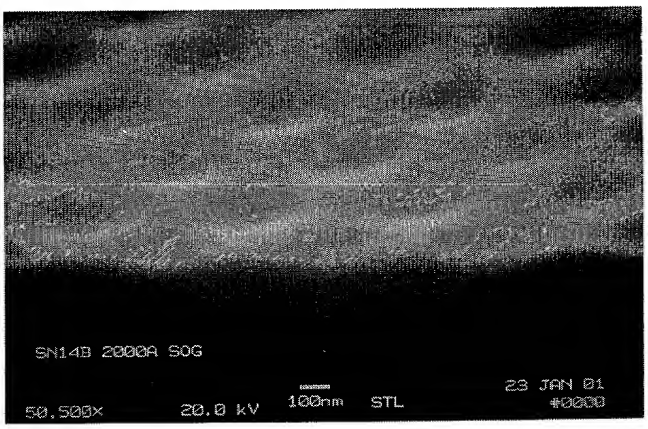


Figure 23

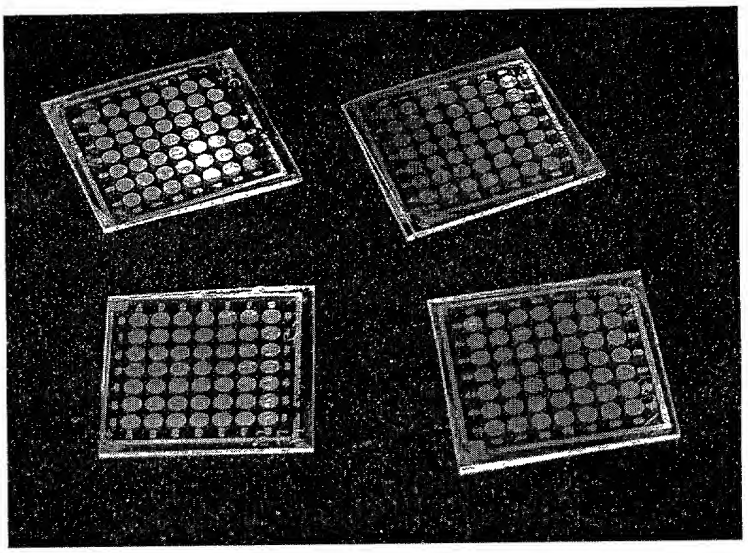


Figure 24

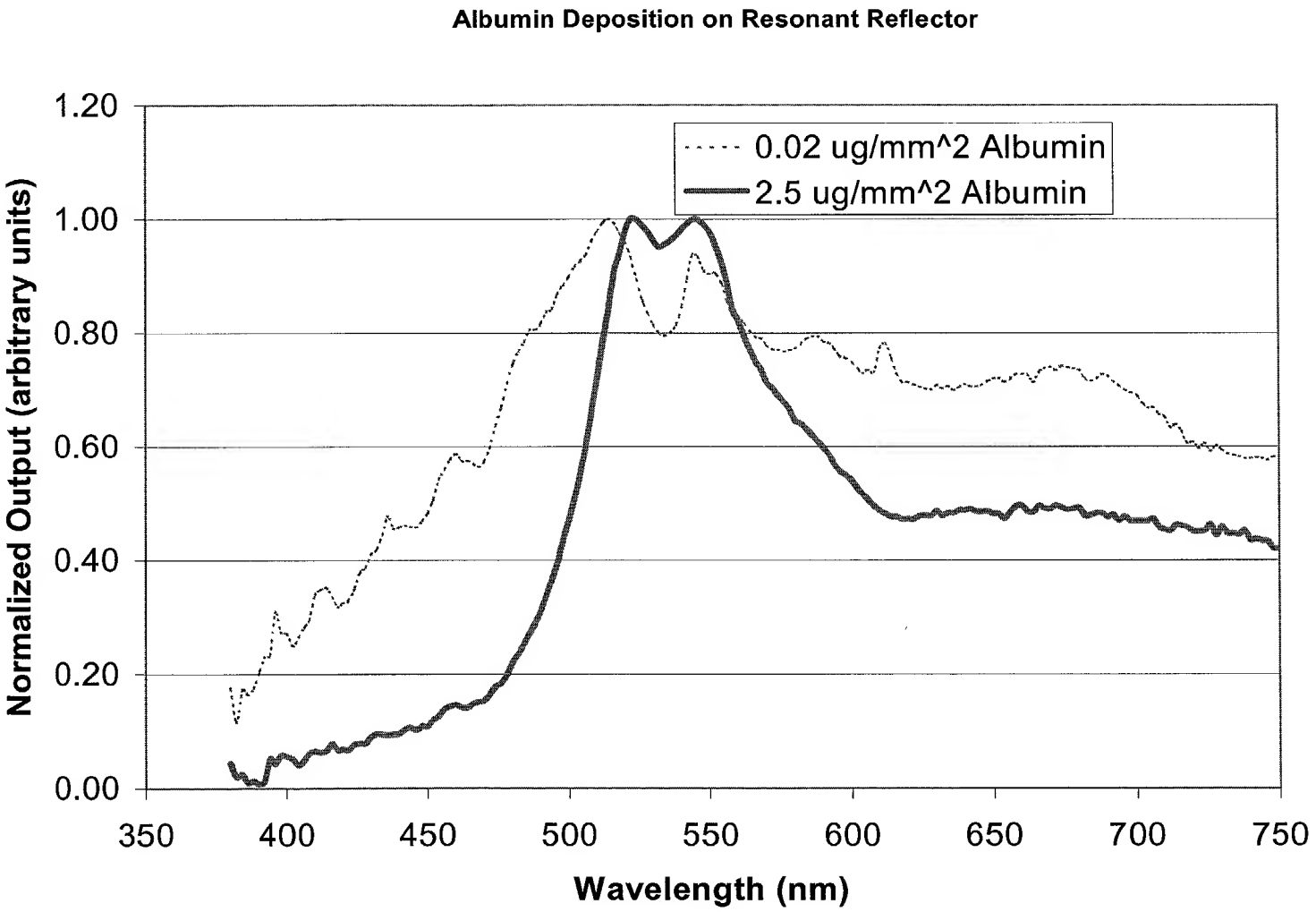

Albumin Deposition on Resonant Reflector
0.02 ug/mm^2 Albumin
2.5 ug/mm^2 Albumin
Normalized Output (arbitrary units)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
350
400
450
500
550
600
650
700
750
Wavelength (nm)

Figure 25

Figure 26

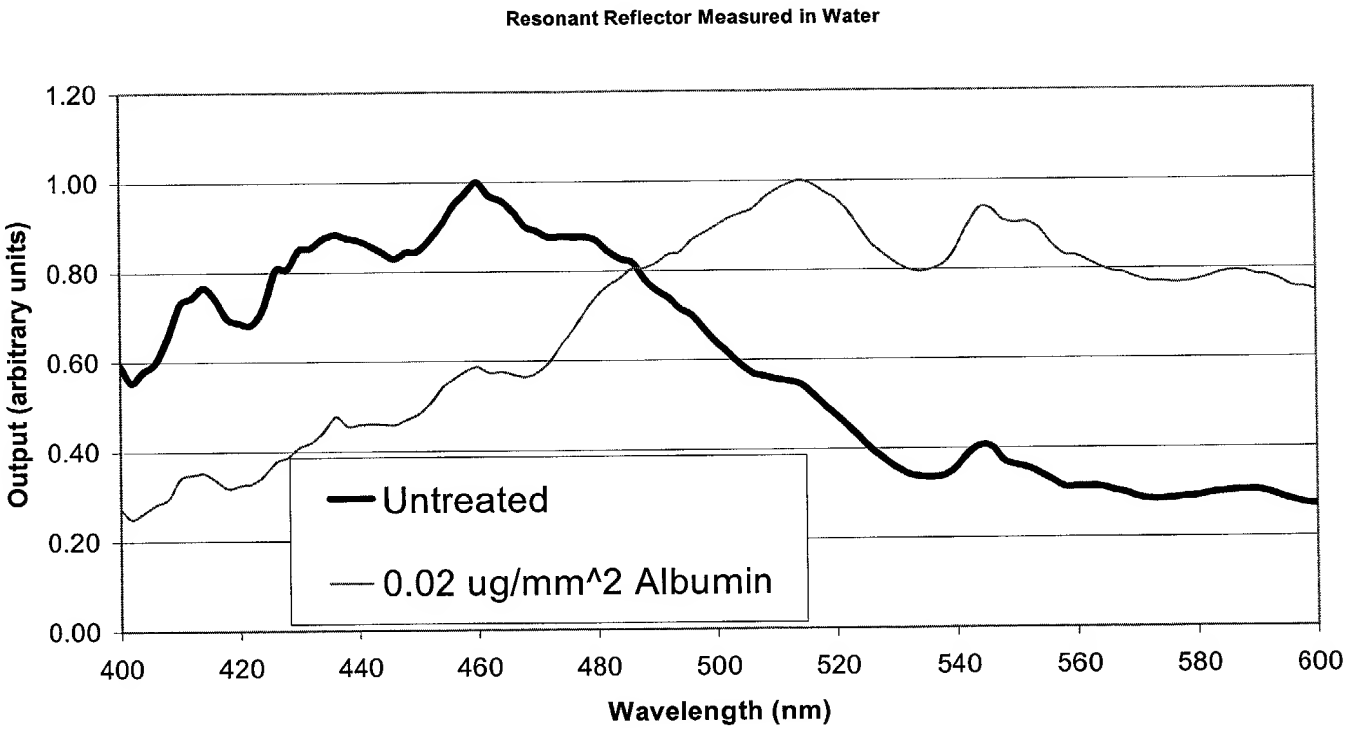

Resonant Reflector Measured in Water
Output (arbitrary units)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
400
420
440
460
480
500
520
540
560
580
600
Wavelength (nm)
Untreated
0.02 ug/mm^2 Albumin

Figure 27

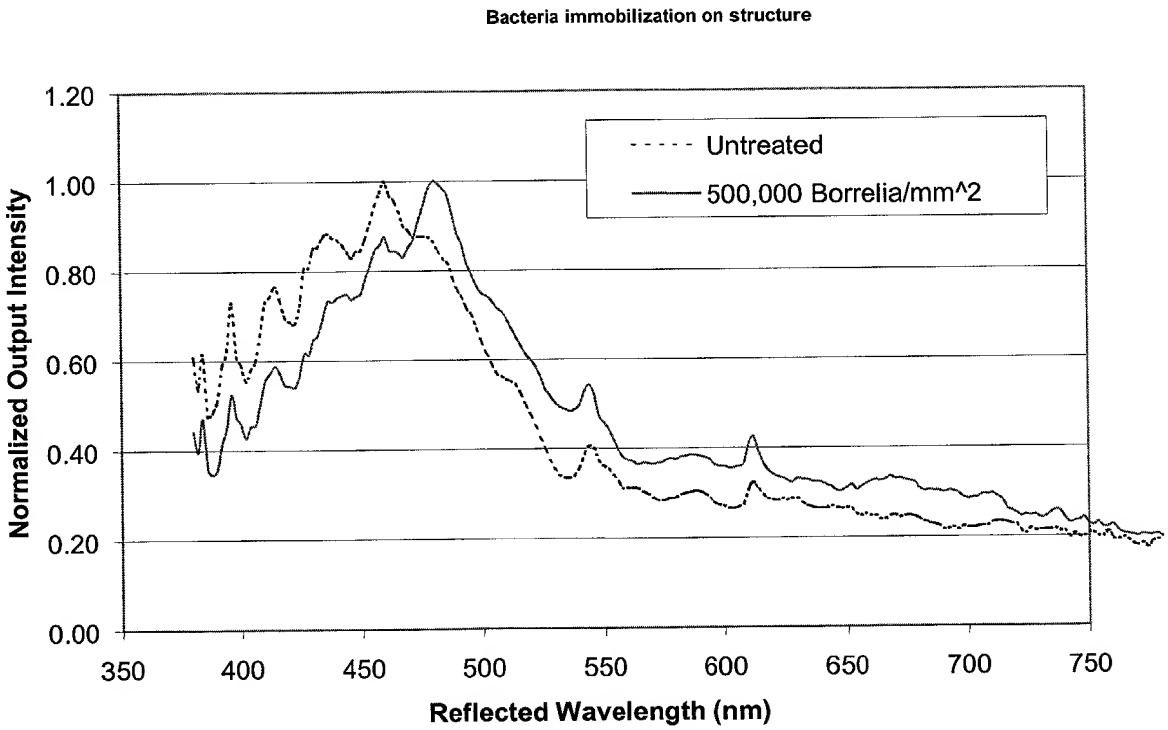
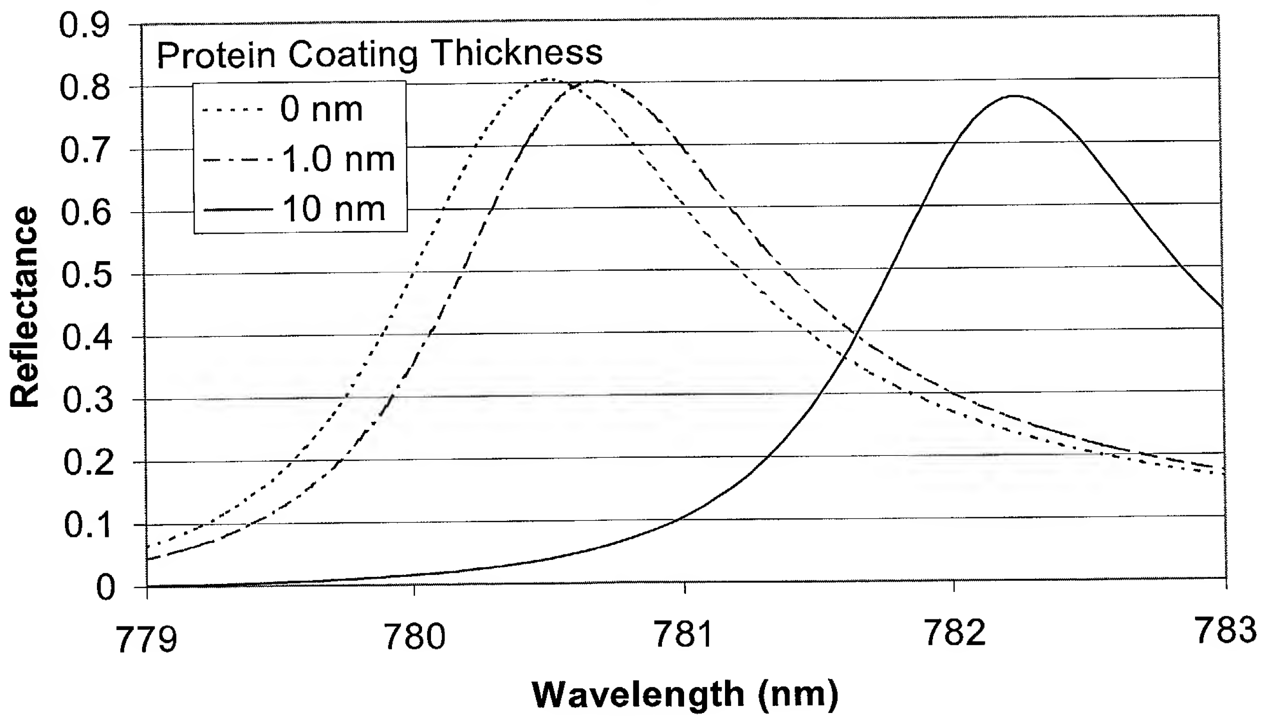
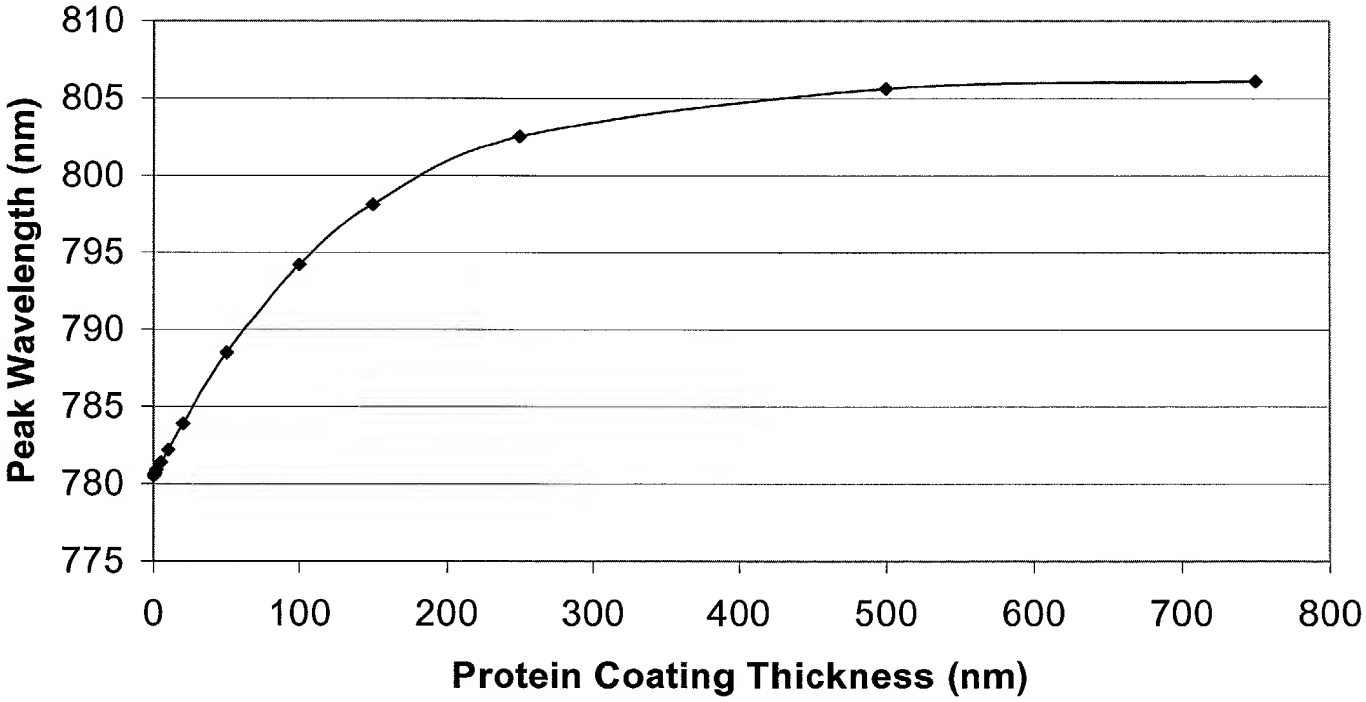

Bacteria immobilization on structure
Untreated
500,000 Borrelia/mm^2
Normalized Output Intensity
1.20
1.00
0.80
0.60
0.40
0.20
0.00
350
400
450
500
550
600
650
700
750
Reflected Wavelength (nm)

Figure 28



Protein Coating Thickness
0 nm
1.0 nm
10 nm
Reflectance
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
779
780
781
782
783
Wavelength (nm)

Figure 29


Peak Wavelength (nm)
810
805
800
795
790
785
780
775
0
100
200
300
400
500
600
700
800
Protein Coating Thickness (nm)

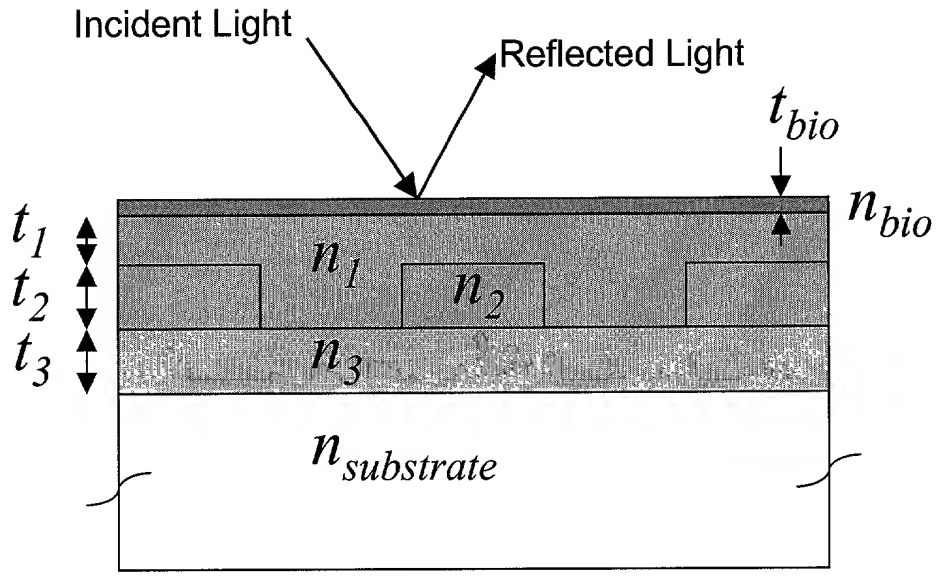

Incident Light
Reflected Light
t_{bio}
n_{bio}
t_1
t_2
t_3
n_1
n_2
n_3
$n_{substrate}$

FIGURE 30

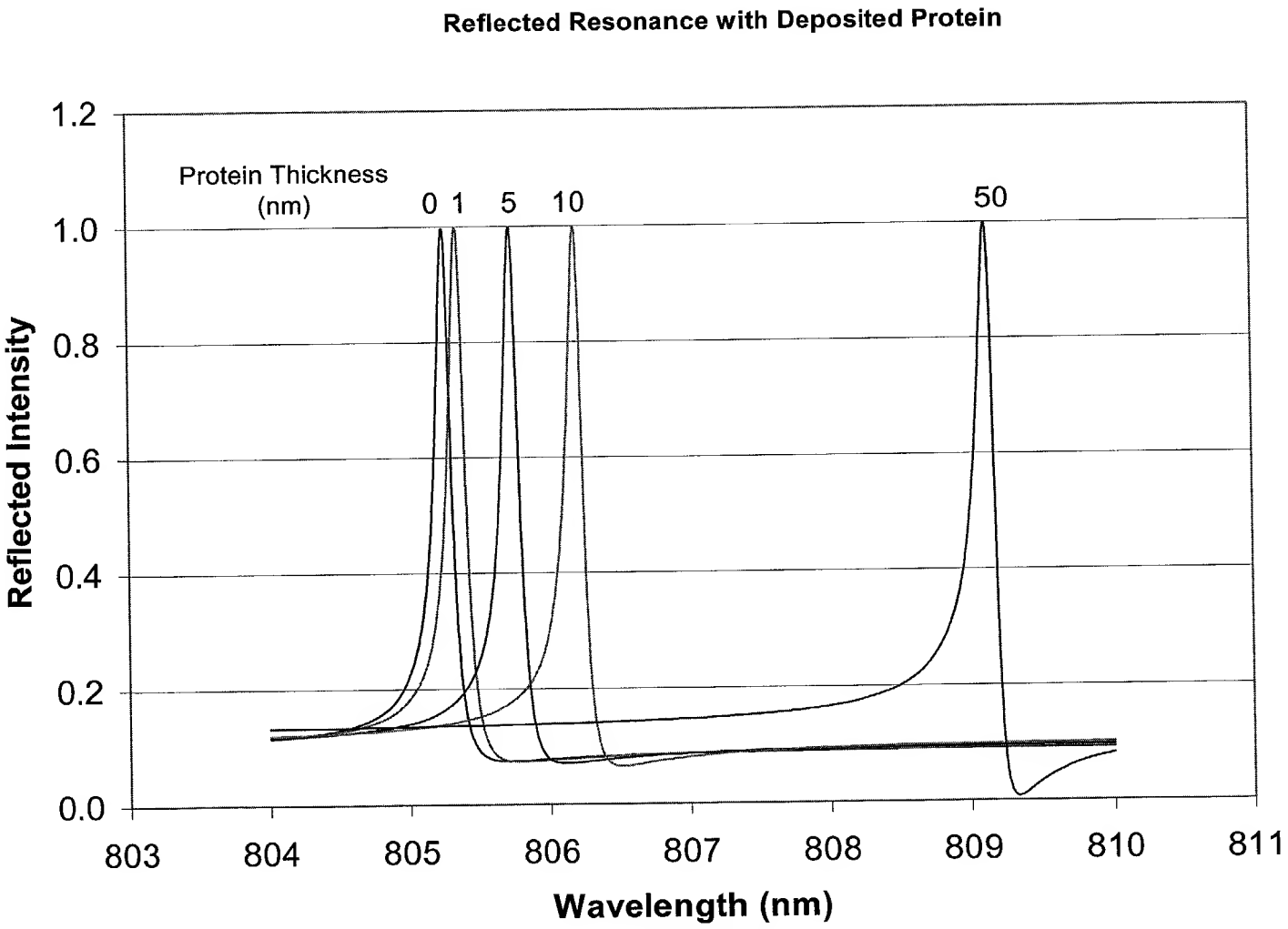


Figure 31

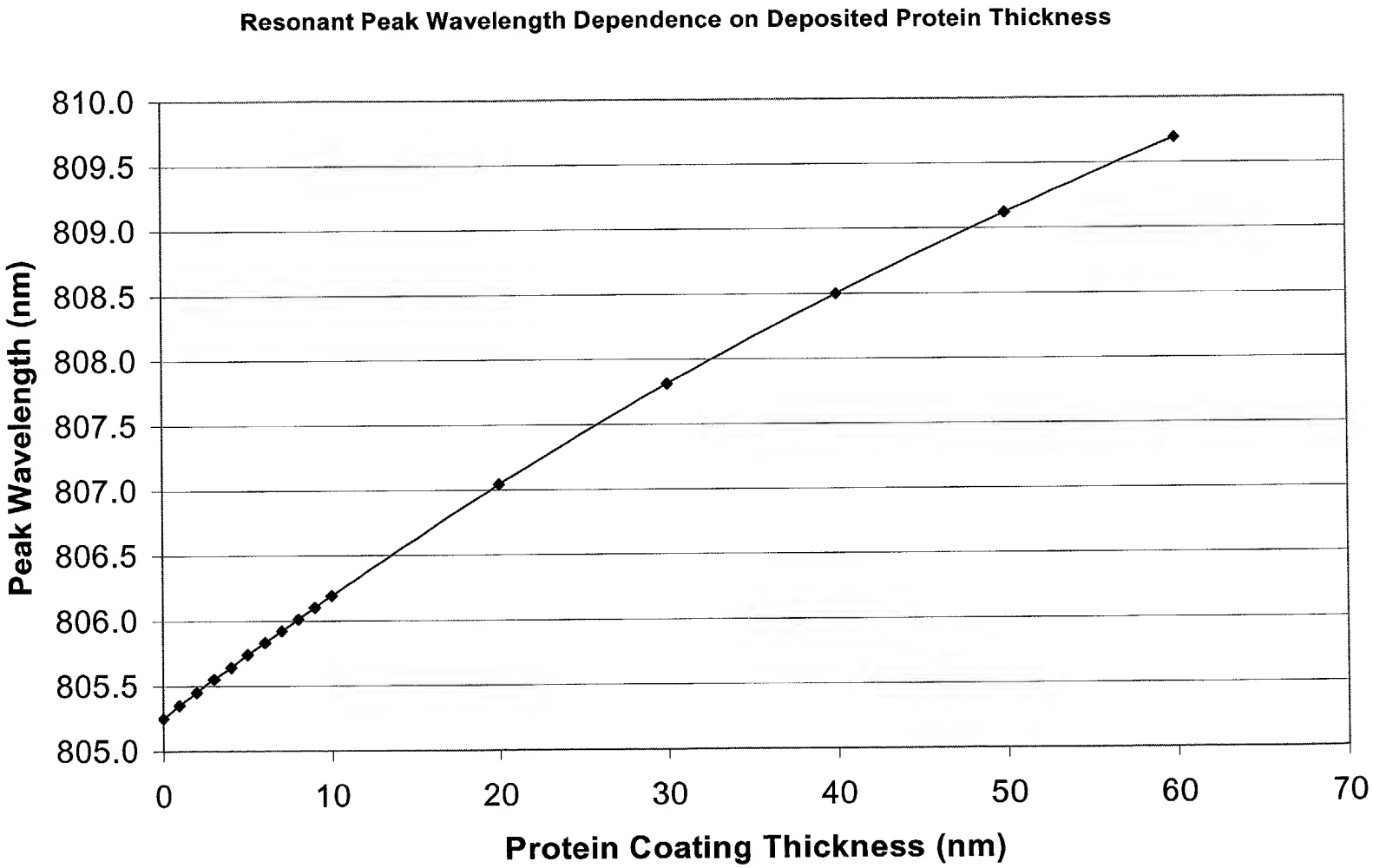

Resonant Peak Wavelength Dependence on Deposited Protein Thickness
Peak Wavelength (nm)
810.0
809.5
809.0
808.5
808.0
807.5
807.0
806.5
806.0
805.5
805.0
0
10
20
30
40
50
60
70
Protein Coating Thickness (nm)

Figure 32

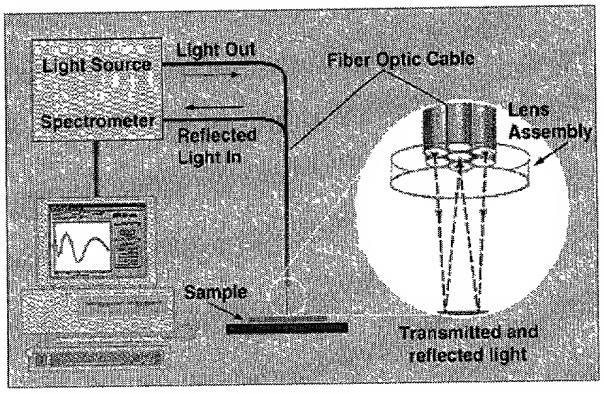


Figure 33

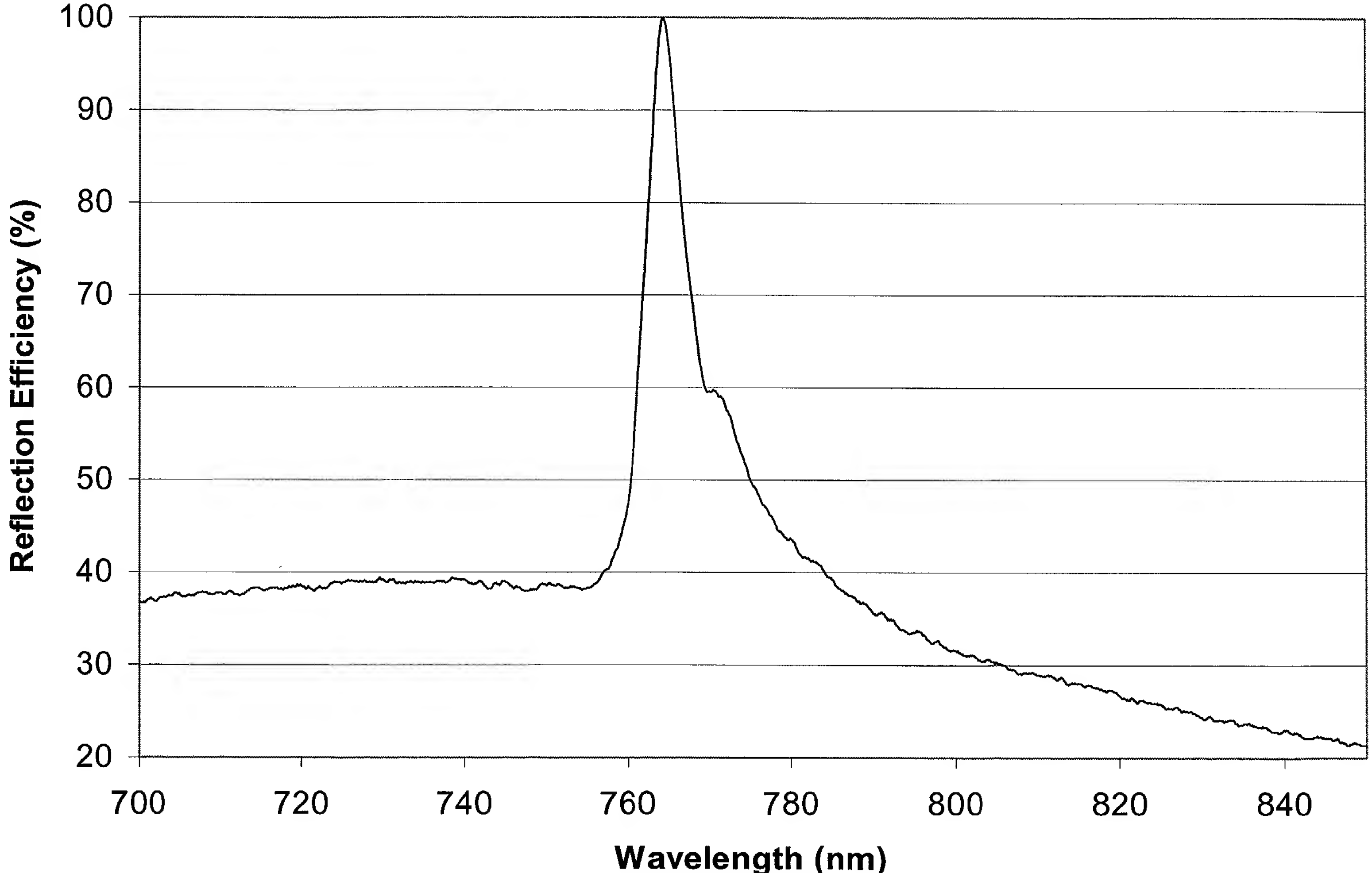
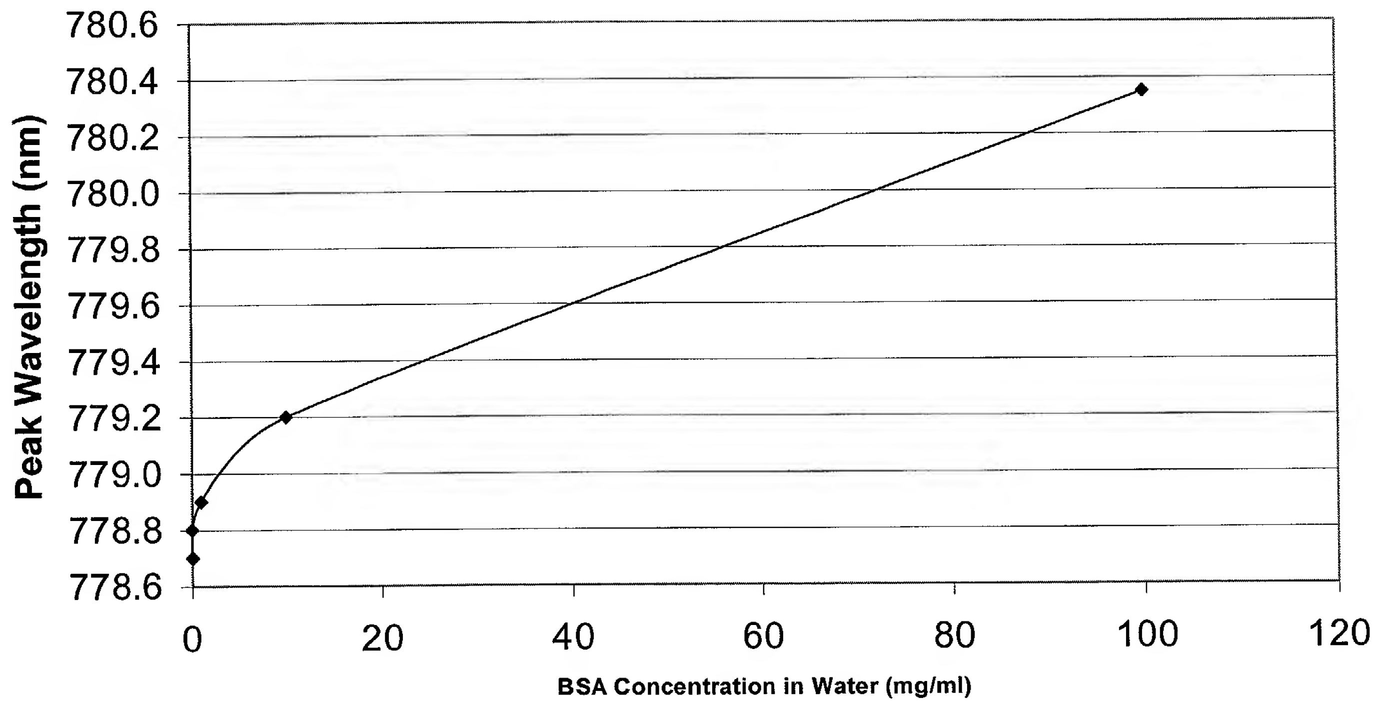

100
90
80
70
60
50
40
30
20
Reflection Efficiency (%)
700
720
740
760
780
800
820
840
Wavelength (nm)
Figure 34

Figure 35



Peak Wavelength (nm)
780.6
780.4
780.2
780.0
779.8
779.6
779.4
779.2
779.0
778.8
778.6
0
20
40
60
80
100
120
BSA Concentration in Water (mg/ml)

Figure 36

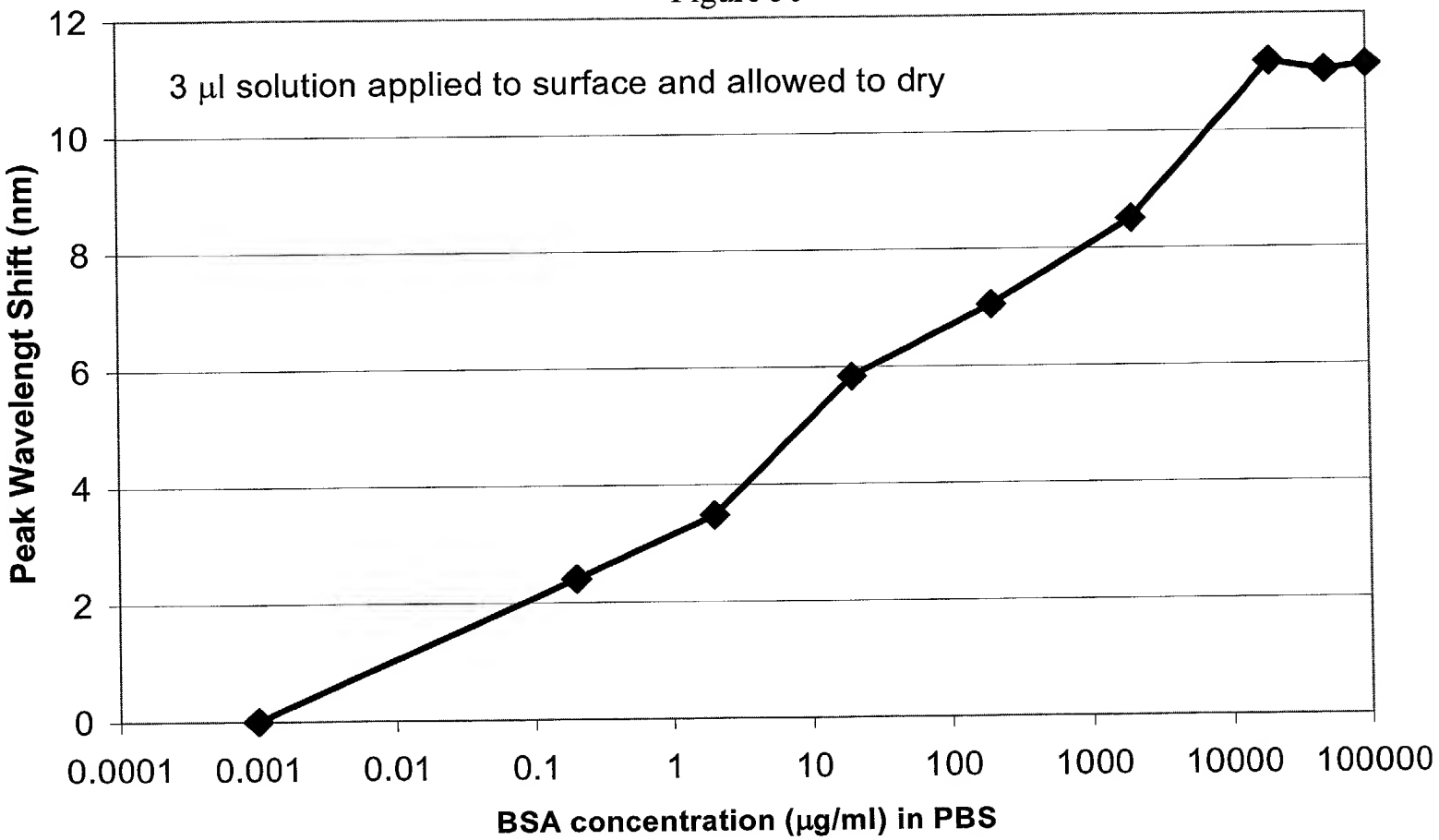

3 µl solution applied to surface and allowed to dry
Peak Wavelengt Shift (nm)
12
10
8
6
4
2
0
0.0001
0.001
0.01
0.1
1
10
100
1000
10000
100000
BSA concentration (µg/ml) in PBS

Figure 37A

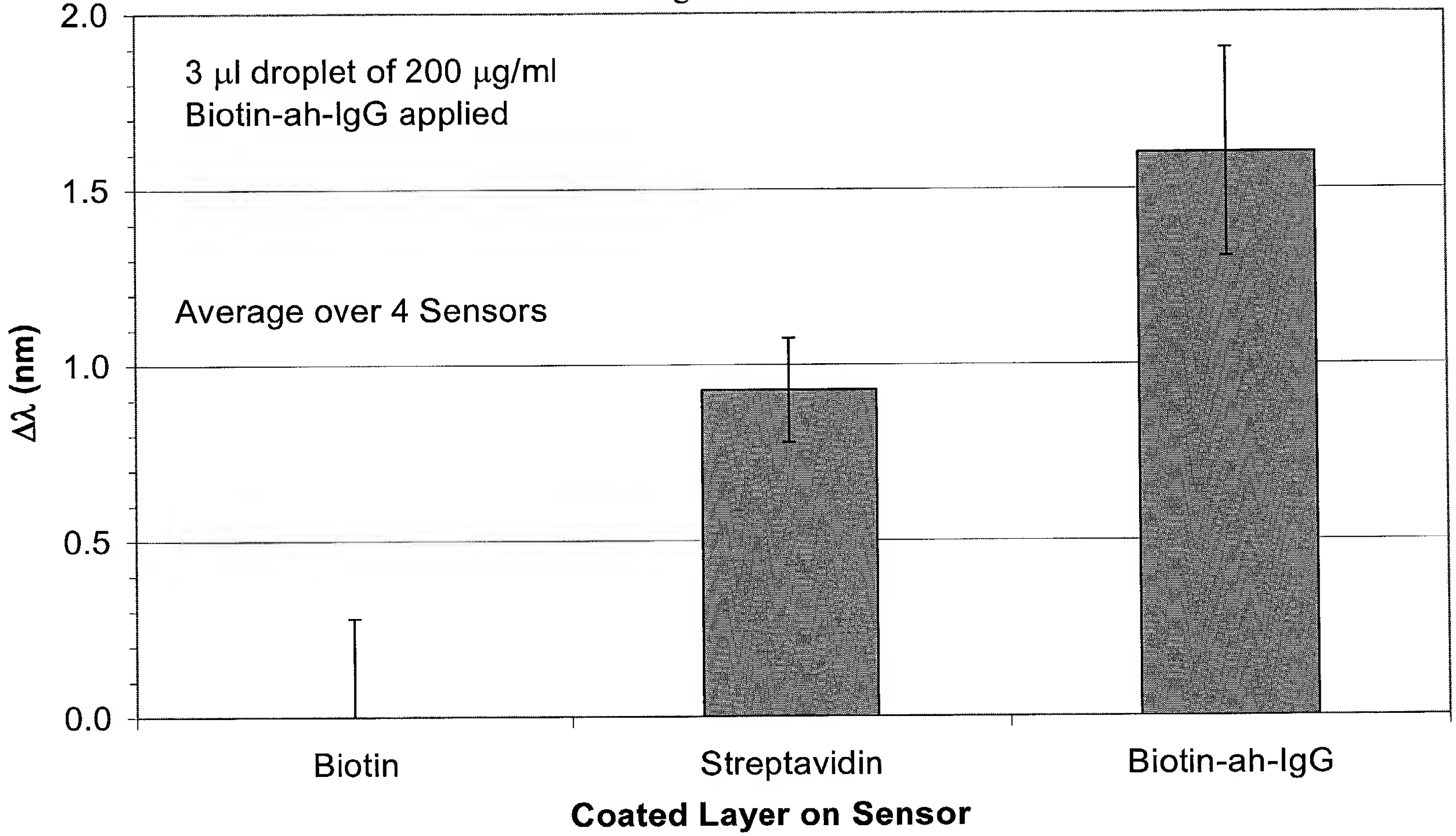
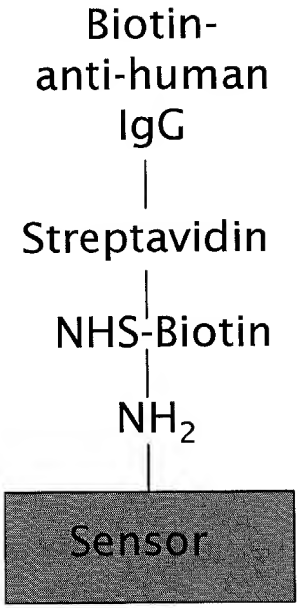

3 μl droplet of 200 μg/ml
Biotin-ah-IgG applied
Average over 4 Sensors
Δλ (nm)
2.0
1.5
1.0
0.5
0.0
Biotin
Streptavidin
Biotin-ah-IgG
Coated Layer on Sensor

Figure 37B



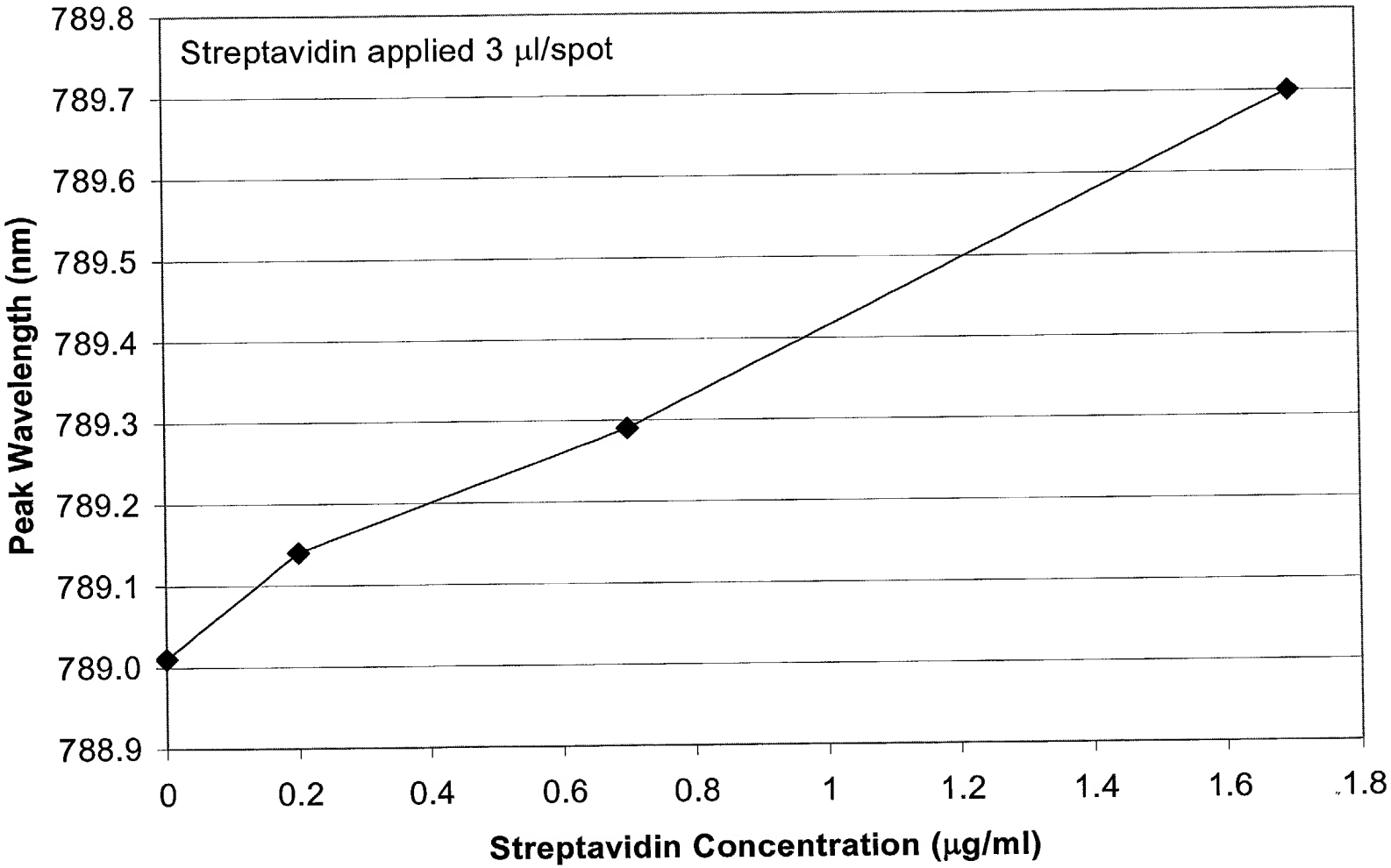
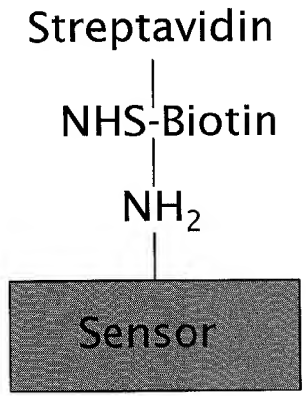

Streptavidin applied 3 µl/spot
Peak Wavelength (nm)
789.8
789.7
789.6
789.5
789.4
789.3
789.2
789.1
789.0
788.9
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
Streptavidin Concentration (µg/ml)

Figure 38A

Figure 38B



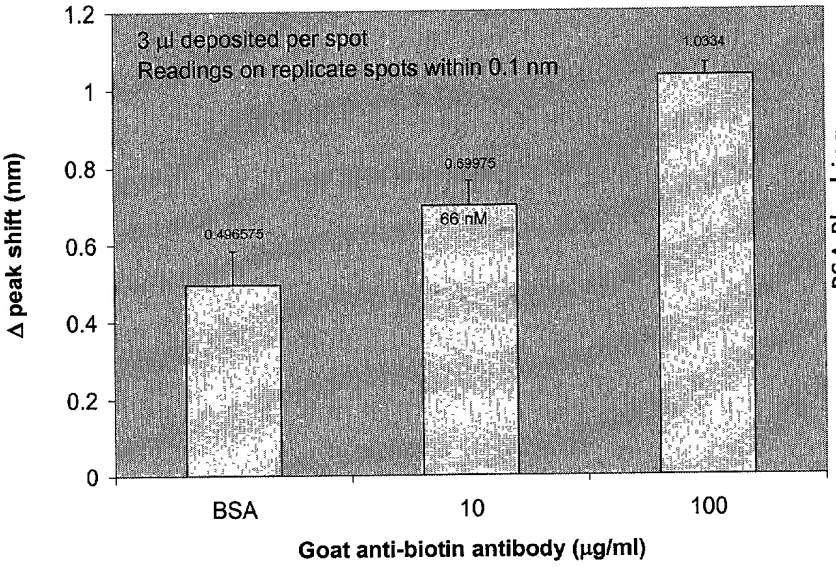


Figure 39A

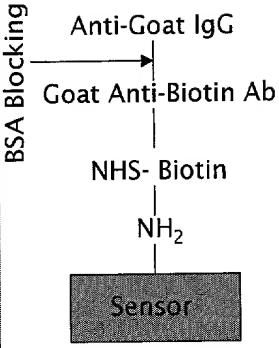


Figure 39B

Figure 39

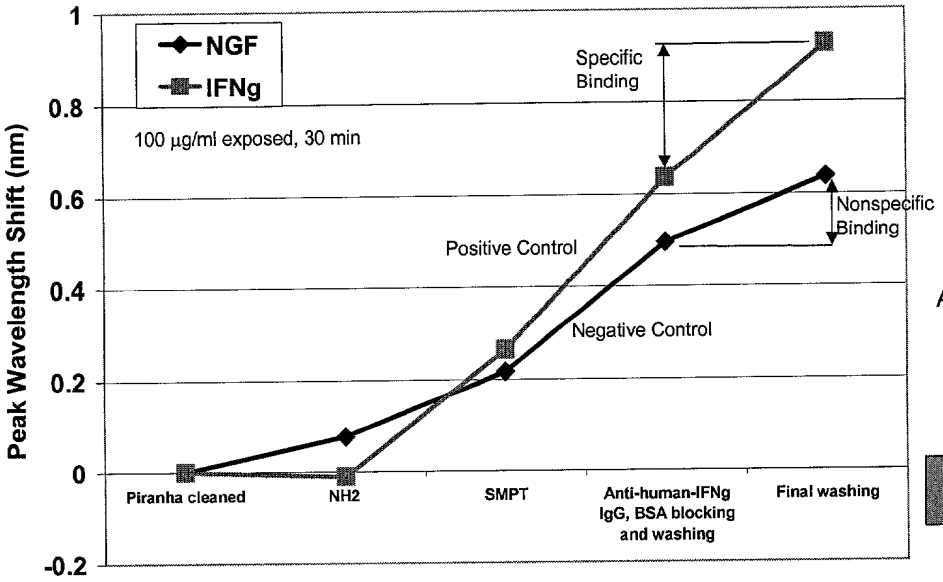


Figure 40A

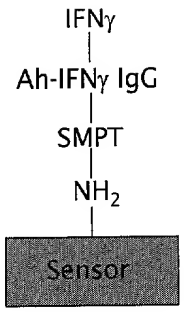


Figure 40B

Figure 40

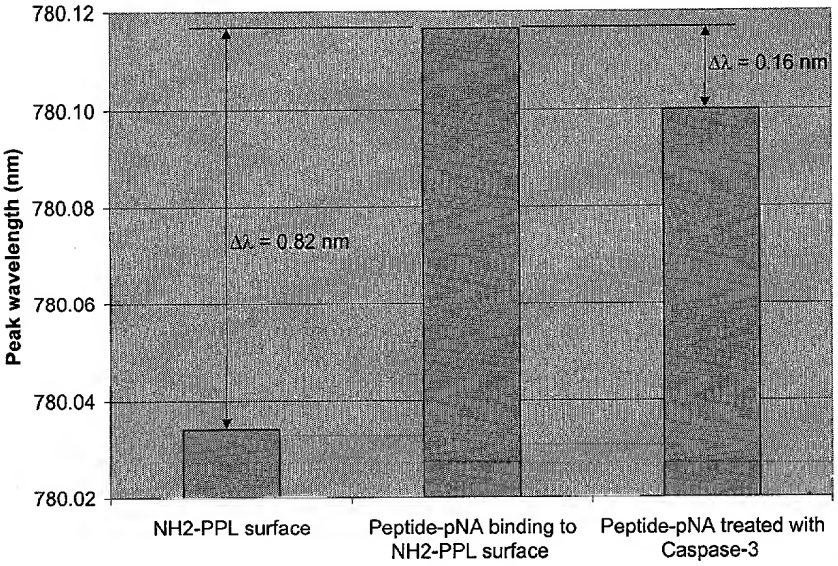


Figure 41A

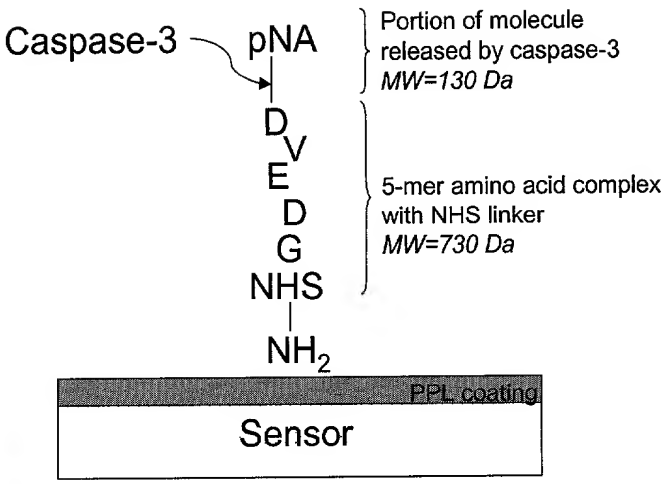


Figure 41B

Figure 41

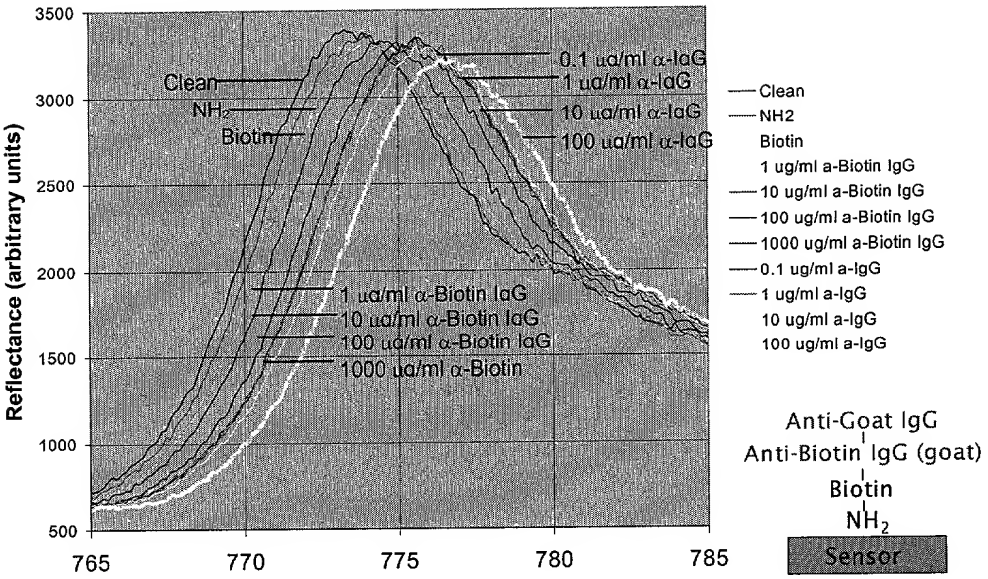


Figure 42A

Figure 42B

Figure 42

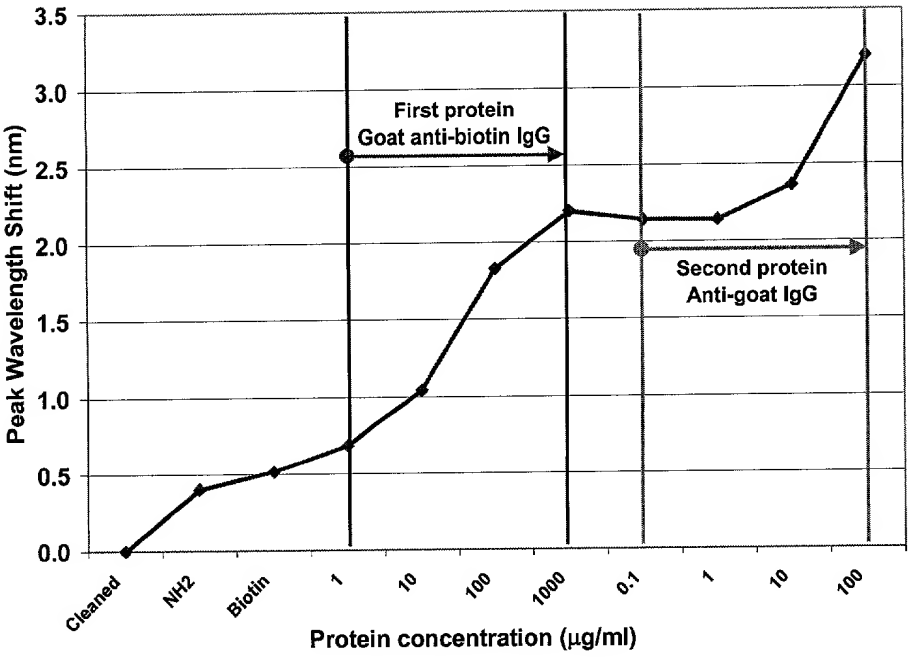


Figure 43A

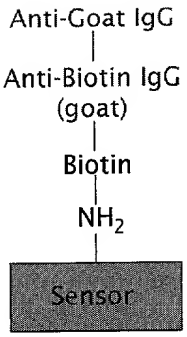


Figure 43B

Figure 43

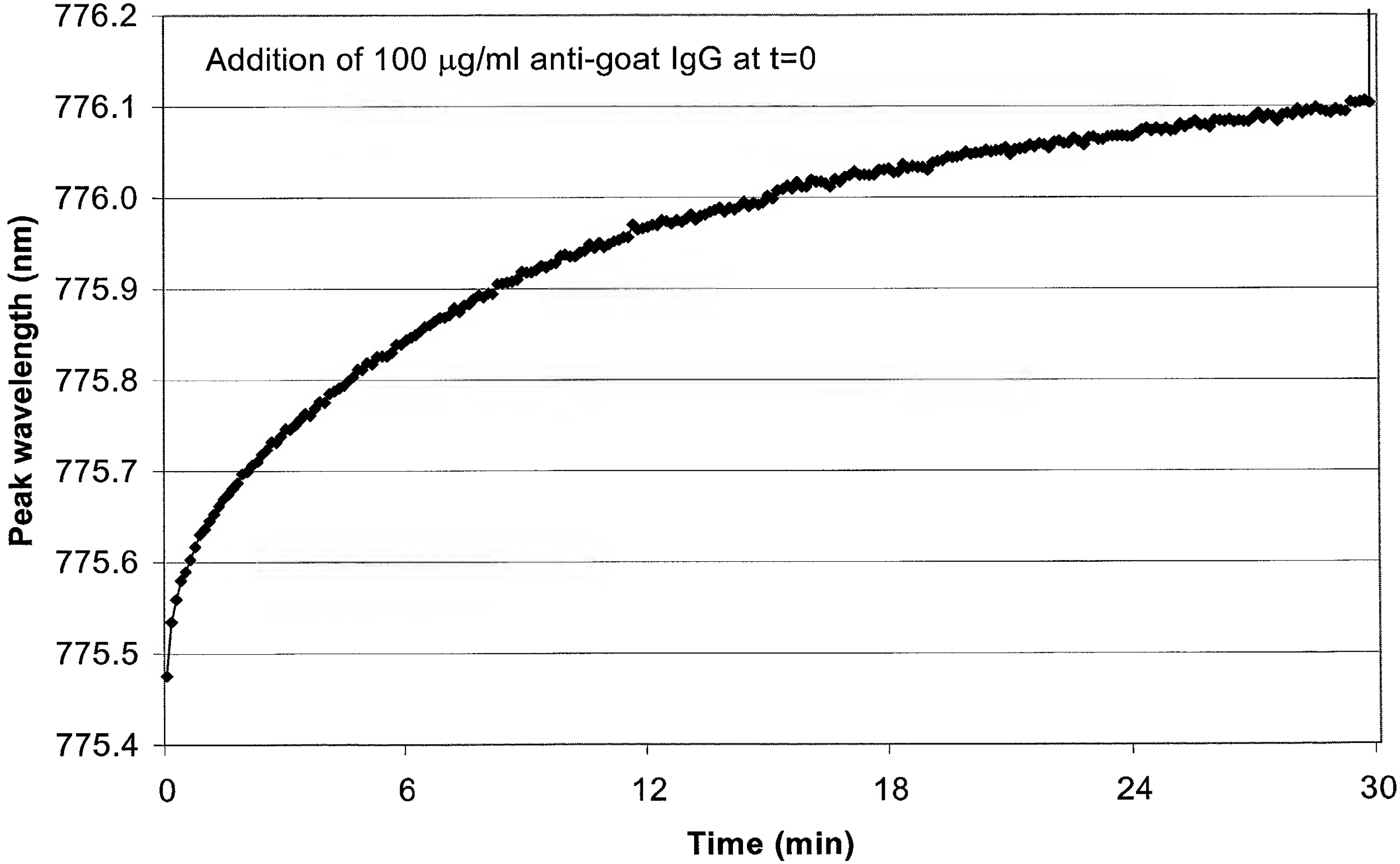
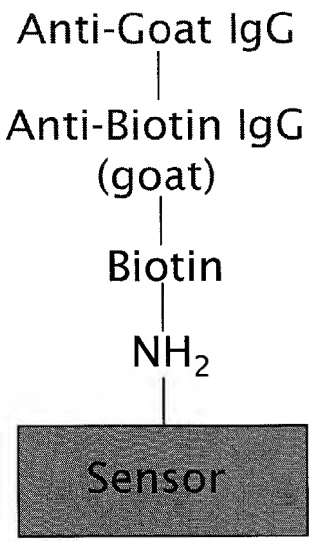

Addition of 100 μg/ml anti-goat IgG at t=0
Peak wavelength (nm)
776.2
776.1
776.0
775.9
775.8
775.7
775.6
775.5
775.4
0
6
12
18
24
30
Time (min)

Figure 44A

Figure 44B



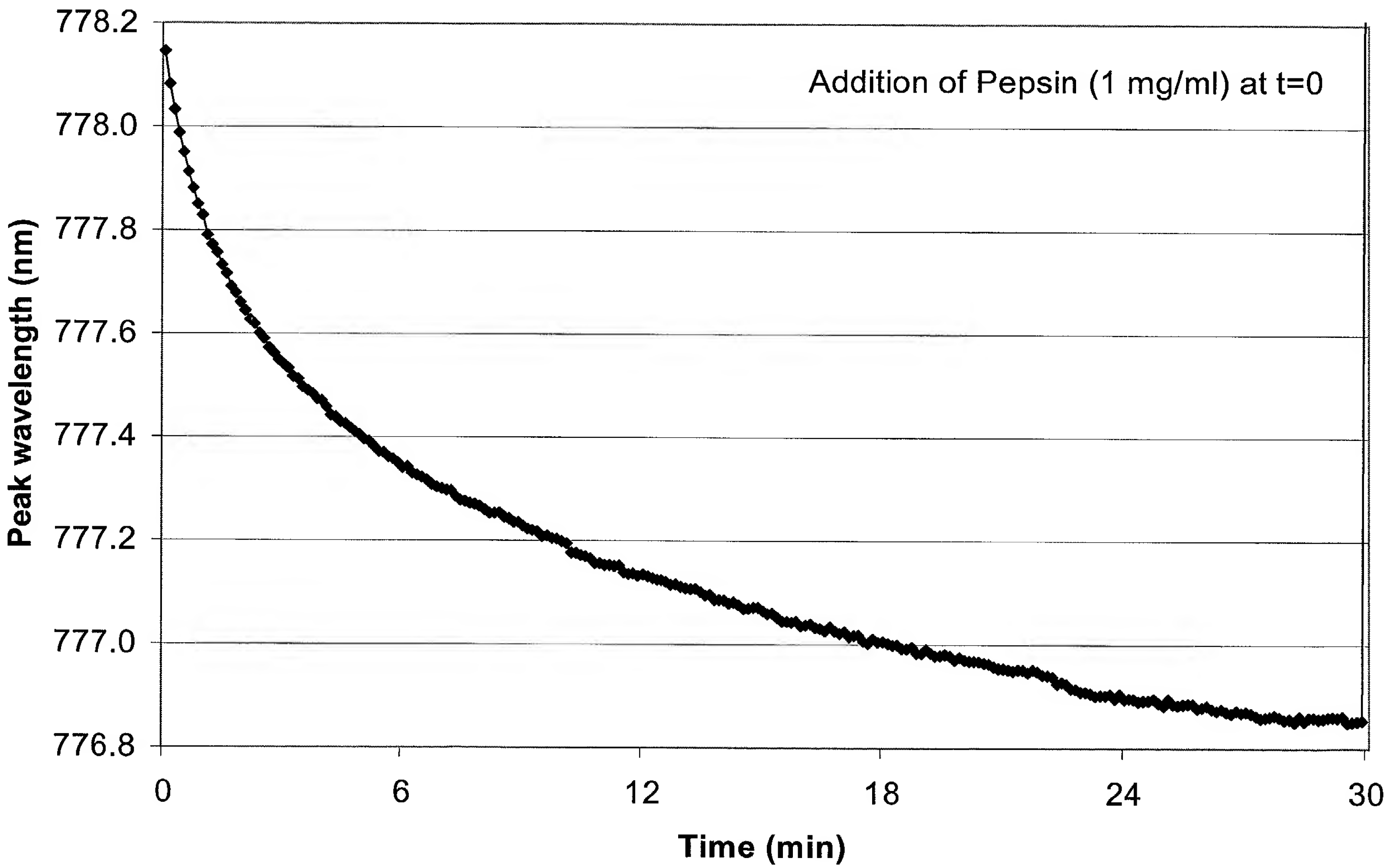
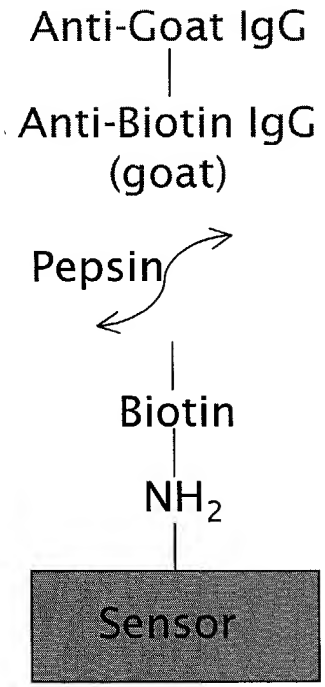

Addition of Pepsin (1 mg/ml) at t=0
Peak wavelength (nm)
778.2
778.0
777.8
777.6
777.4
777.2
777.0
776.8
0
6
12
18
24
30
Time (min)

Figure 45A

Figure 45B



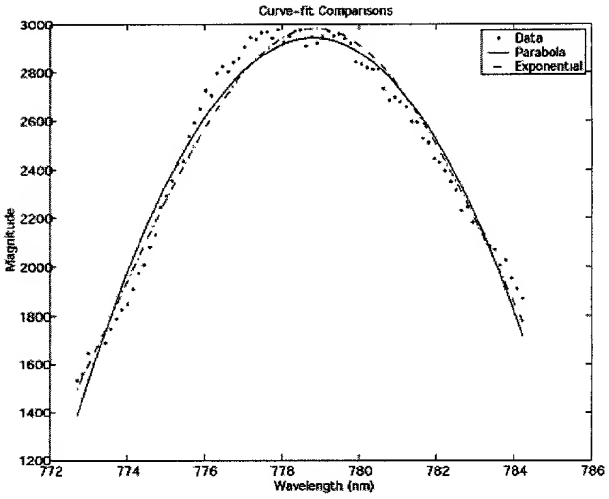

Curve-fit Comparisons
Data
Parabola
Exponential
Magnitude
Wavelength (nm)
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
772
774
776
778
780
782
784
786

Figure 46

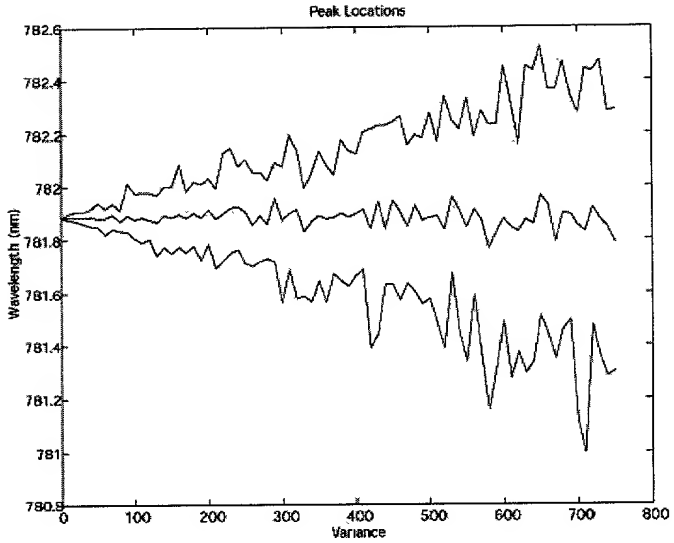
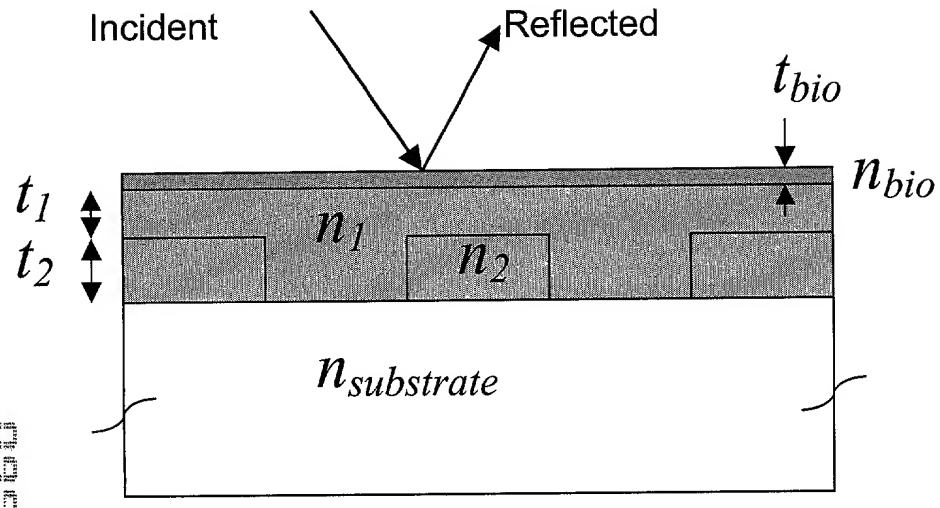

Peak Locations
Wavelength (nm)
Variance
782.6
782.4
782.2
782
781.8
781.6
781.4
781.2
781
780.8
0
100
200
300
400
500
600
700
800

Figure 47



Material 1 = Electrical Insulator (photoresist, epoxy, glass)
Material 2 = Indium tin oxide conductor
Substrate = Glass

FIGURE 48

Concentric Circle Design

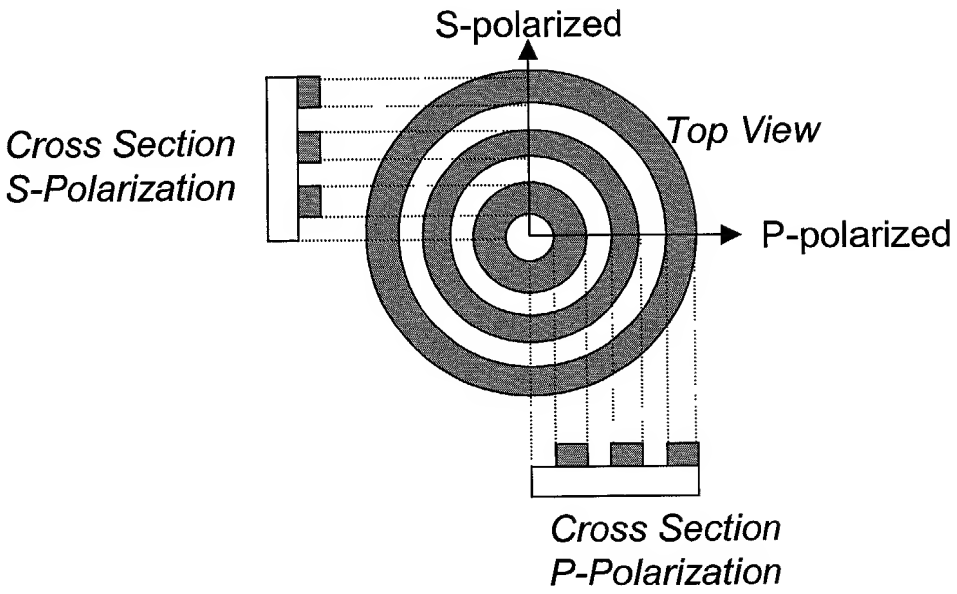


Figure 49

Figure 50

Hexagonal Grid Design

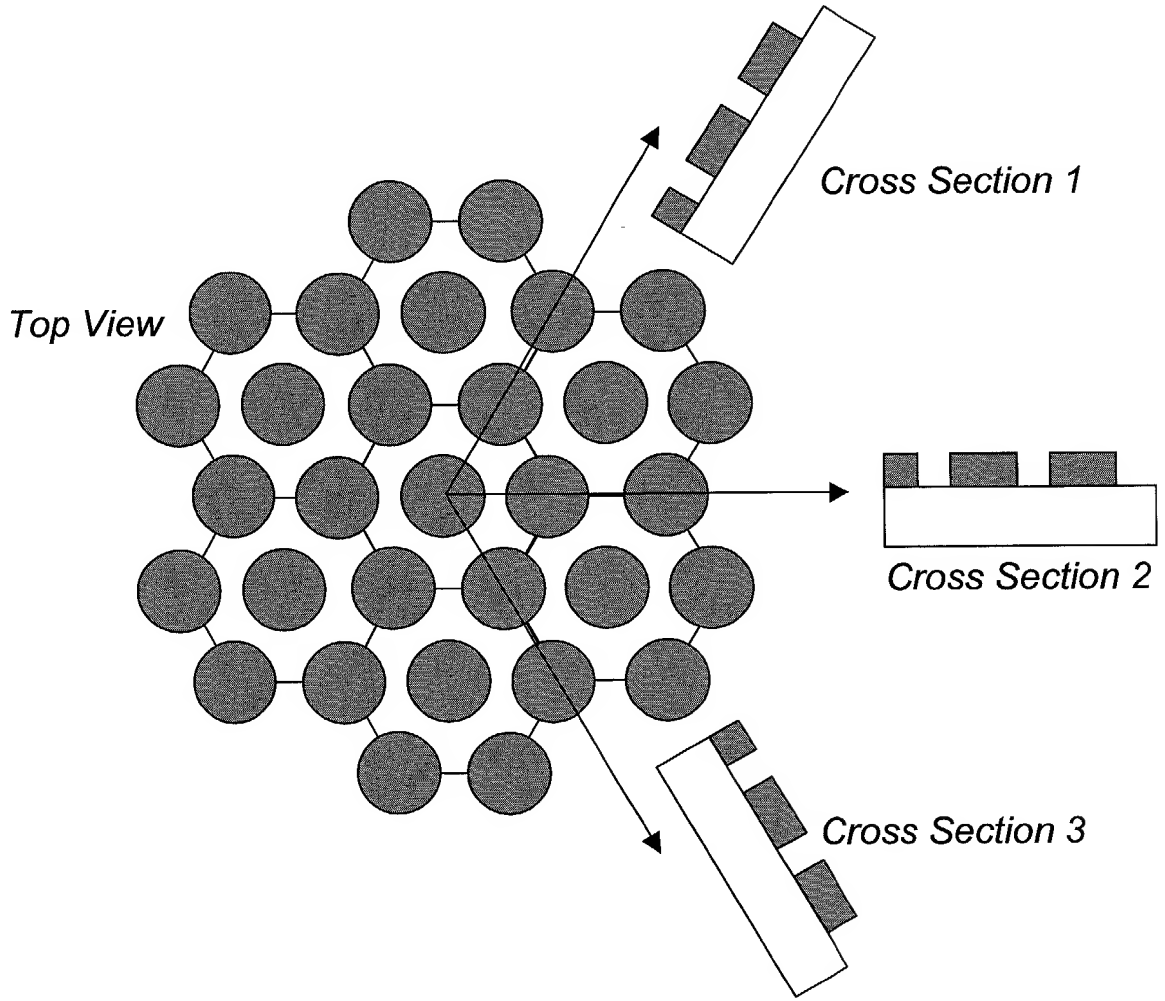
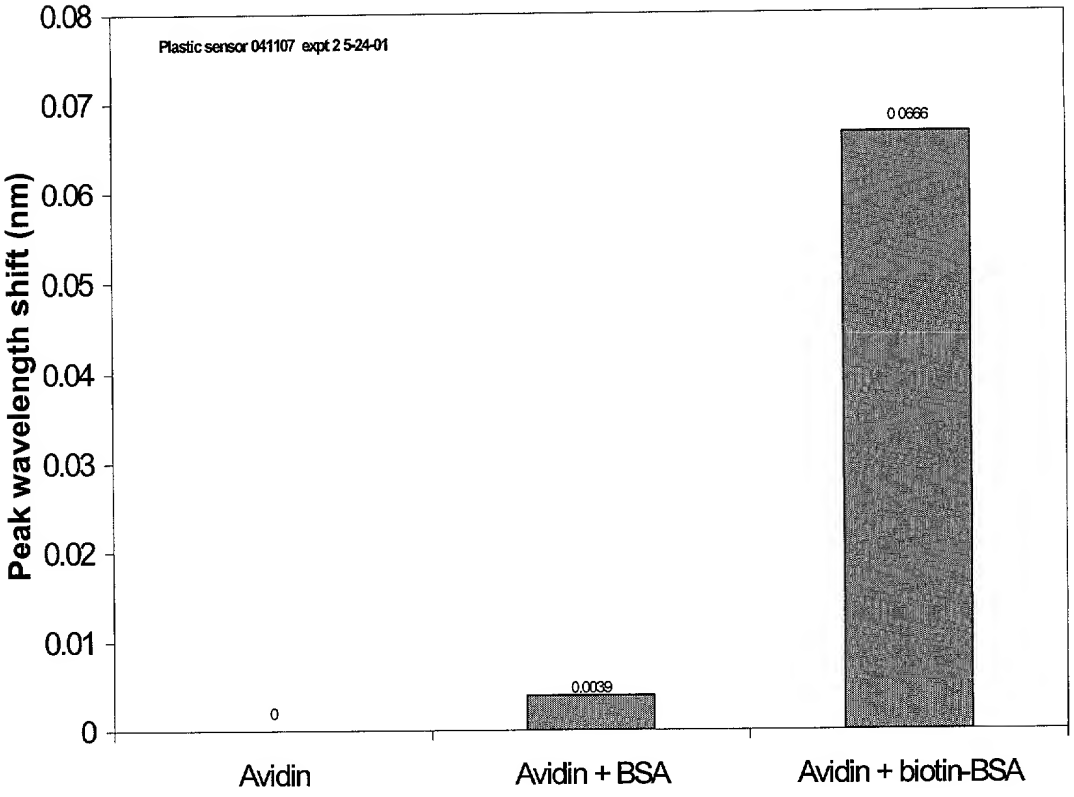
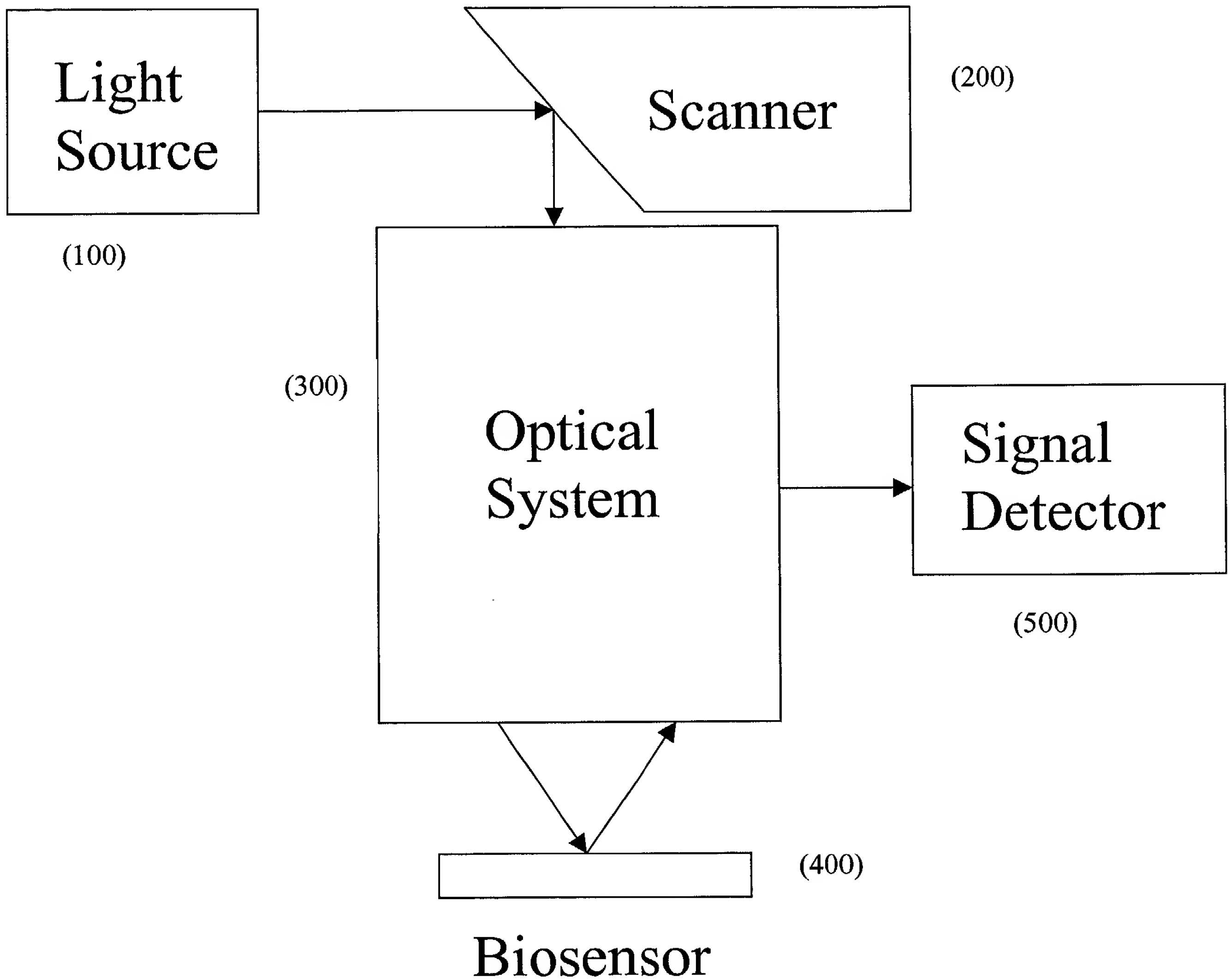


Figure 51


Plastic sensor 041107 expt 2 5-24-01
Peak wavelength shift (nm)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0.0666
0.0039
0
Avidin
Avidin + BSA
Avidin + biotin-BSA



Light
Source
(100)
Scanner
(200)
Optical
System
(300)
Signal
Detector
(500)
(400)
Biosensor

Figure 52